

Instrumental Interaction in Multisurface Environments

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Have you ever been frustrated
when using your computer?

More specifically:

Have you ever missed a feature
that you know exists
in another application?

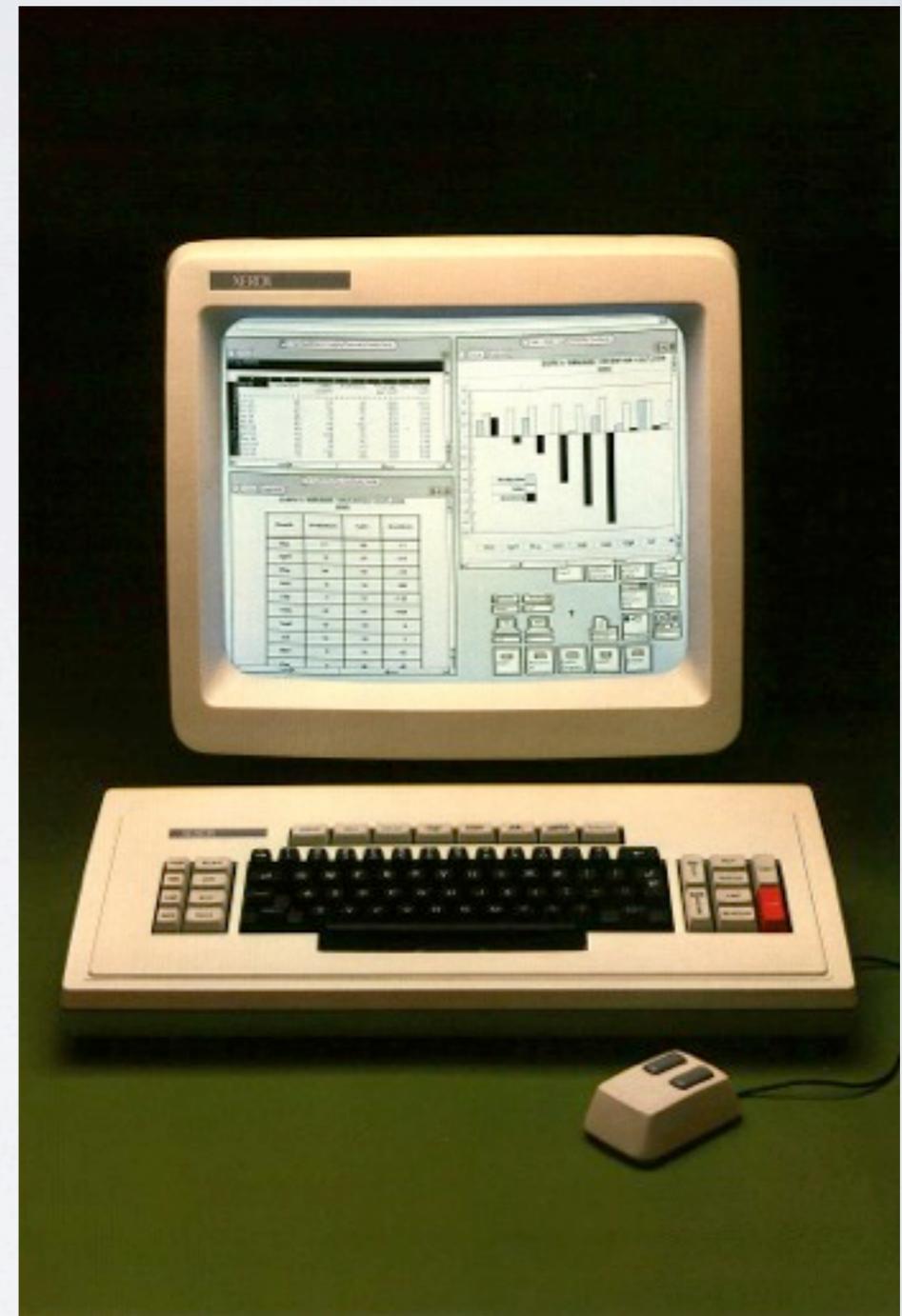
How many interactive devices do you use?

Have you ever wished you could use one of them to control the other?



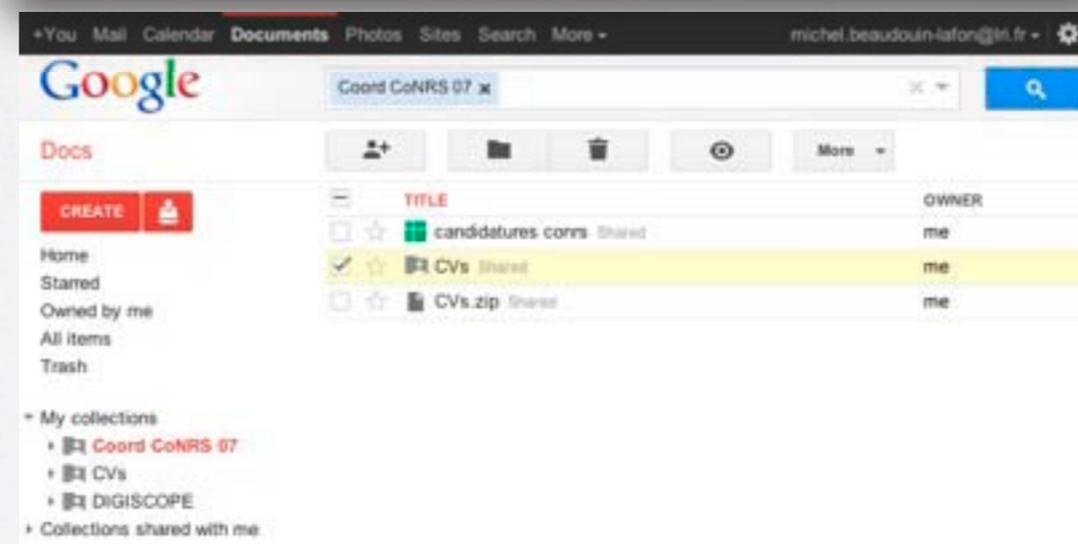
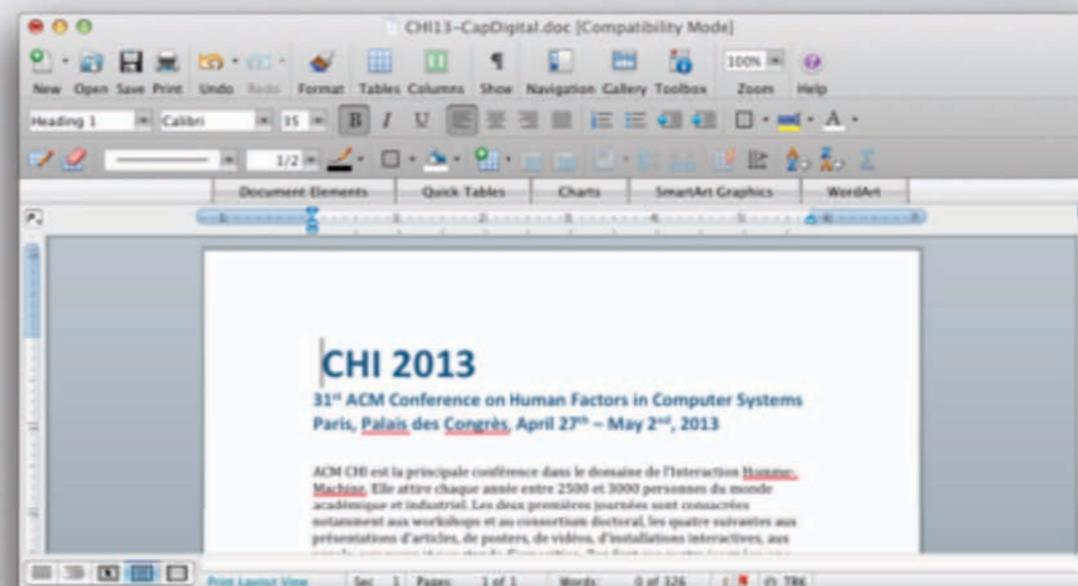
Problem: we're stuck in the past

- Not much change since the Xerox Star in 1981 (30 years!)
- Scalability issues:
 - More diverse users
 - More diverse contexts of use
 - More diverse platforms
 - More and more data



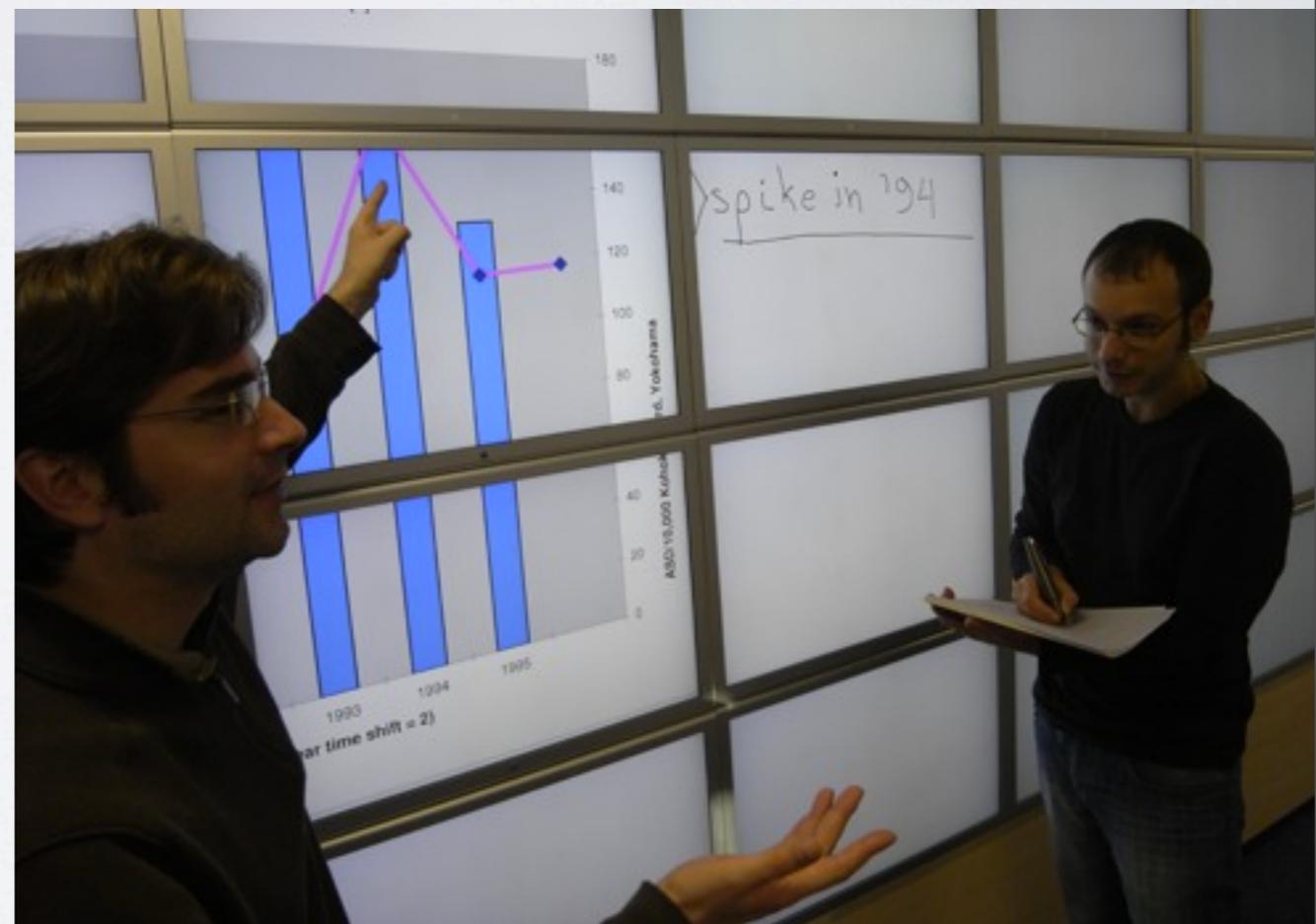
Problem: we're stuck in applications

- Applications bundle the management of data of a certain type with the interaction to manipulate it
- Desktop applications
- Web apps
- Apps for smartphones and tablets



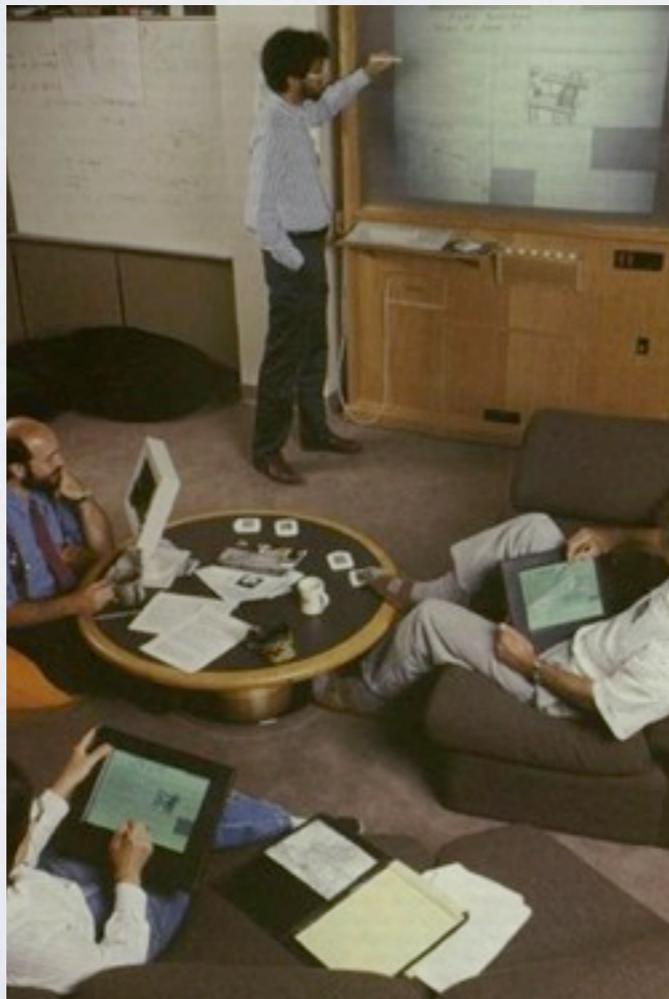
Things are about to become even worse

- Interaction surfaces are going to be everywhere
- Multi-user, Multi-surface interaction will become a necessity



What happened to the future promised by Ubicomp?

- “The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are undistinguishable from it.” - Mark Weiser



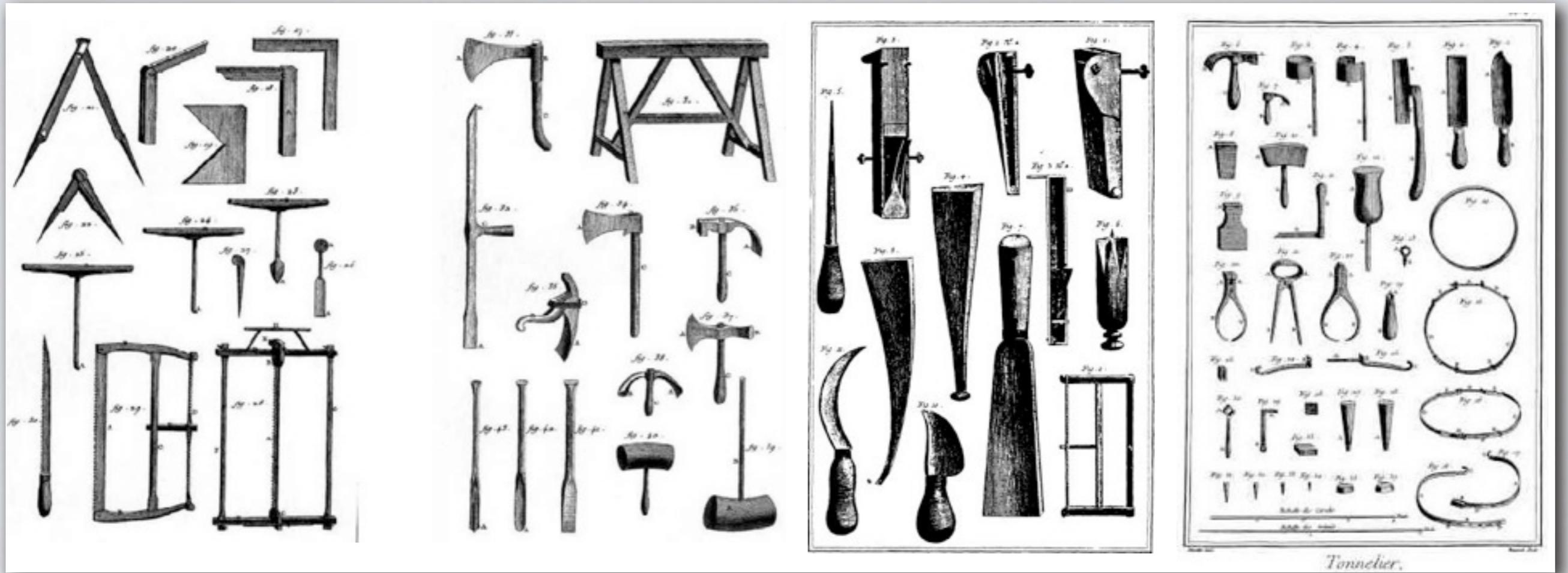
Weiser, 1991



Rekimoto, UIST '97

We need a
new Interaction Model
and associated tools
to reinvent user interfaces in
multi-surface environments

Tools and Instruments



L'encyclopédie - Diderot & d'Alembert, 1751-1772



Master Slides

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Slides

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Table

Table Format

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Alternating Row Color

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Media

Audio Photos Movies

iPhoto

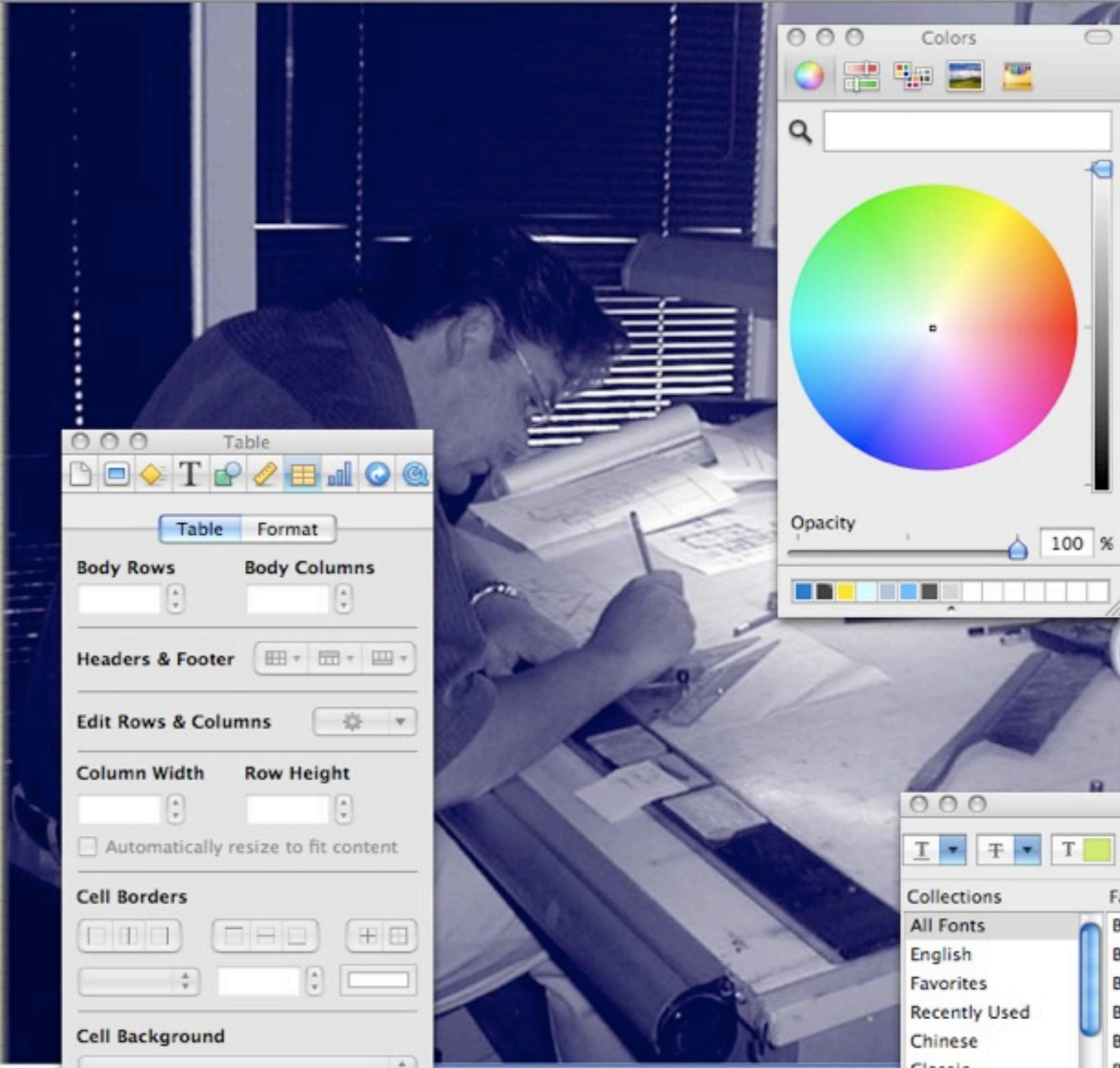
Open iPhoto 5 or later to see photos from your iPhoto Library in this list.

Fonts

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Collections	Family	Typeface	Size
All Fonts	Bodoni Ornaments	Bold	28
English	Bodoni SvtyTwo ITC		9
Favorites	Bodoni SvtyTwo OS		10
Recently Used	Bodoni SvtyTwo SC		11
Chinese	Book Antiqua		12
Classic	Bookman		13
Comic Life	Bookman Old Style		14
Fixed Width	Bordeaux Roman B		18
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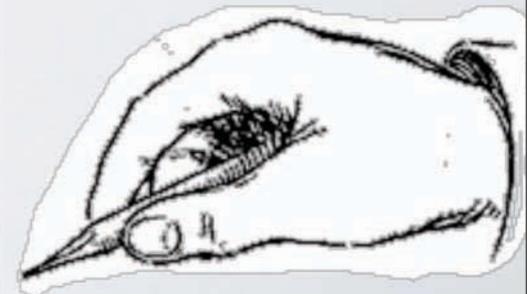


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rather simple tools to do c
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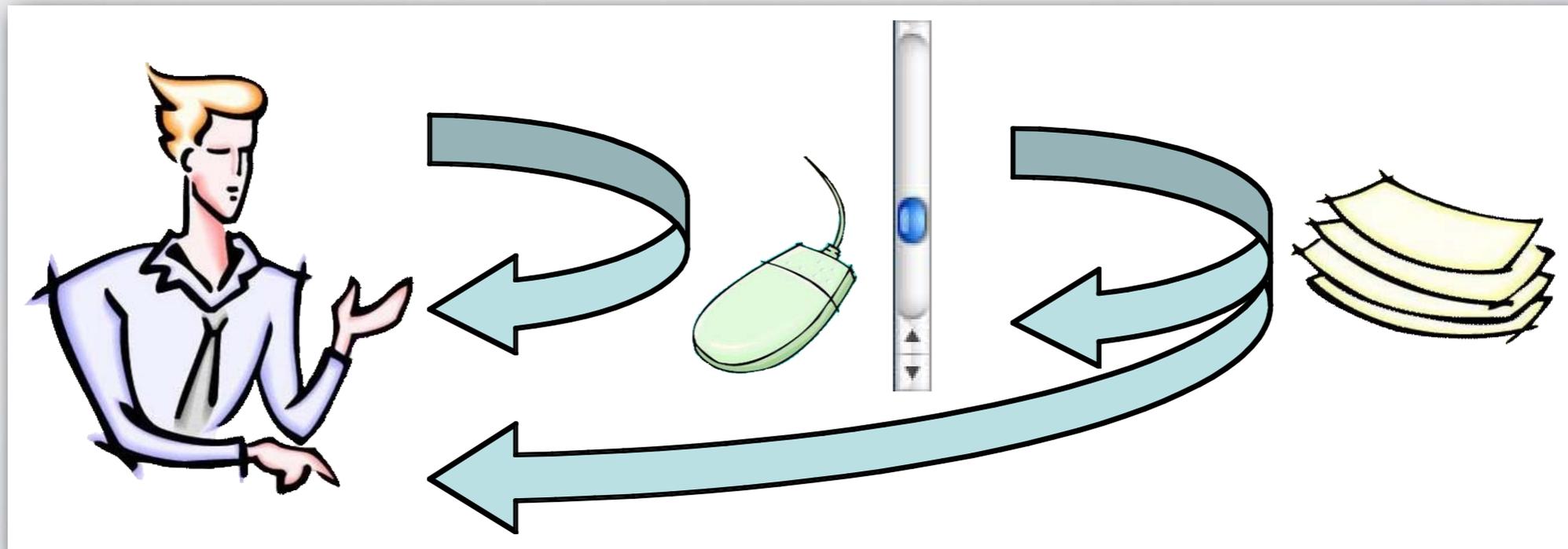
The power of tools

- Gibson's Ecological Theory:
 - Affordances = possibilities for action in the environment relative to the capabilities of the subject
- Tools redefine the affordances of the environment because they change the capabilities of the subject
 - Holding a pen creates affordances for writability



Instrumental Interaction

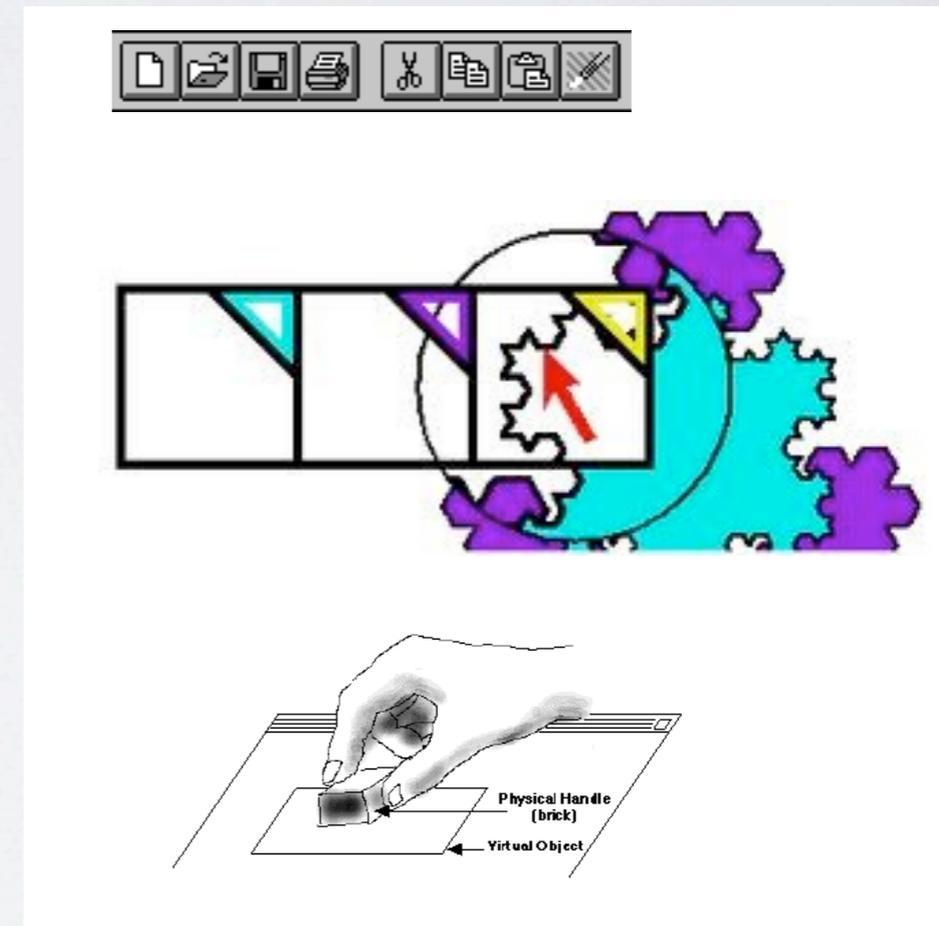
- Mediated interaction: user - instrument - object of interest
- An instrument **reifies** a command
- Use the same instrument with different objects (polymorphism)



Beaudouin-Lafon, CHI '00

Instrumental interaction

- Covers many interaction styles:
 - Traditional GUI
 - Novel techniques
 - Tangible interaction

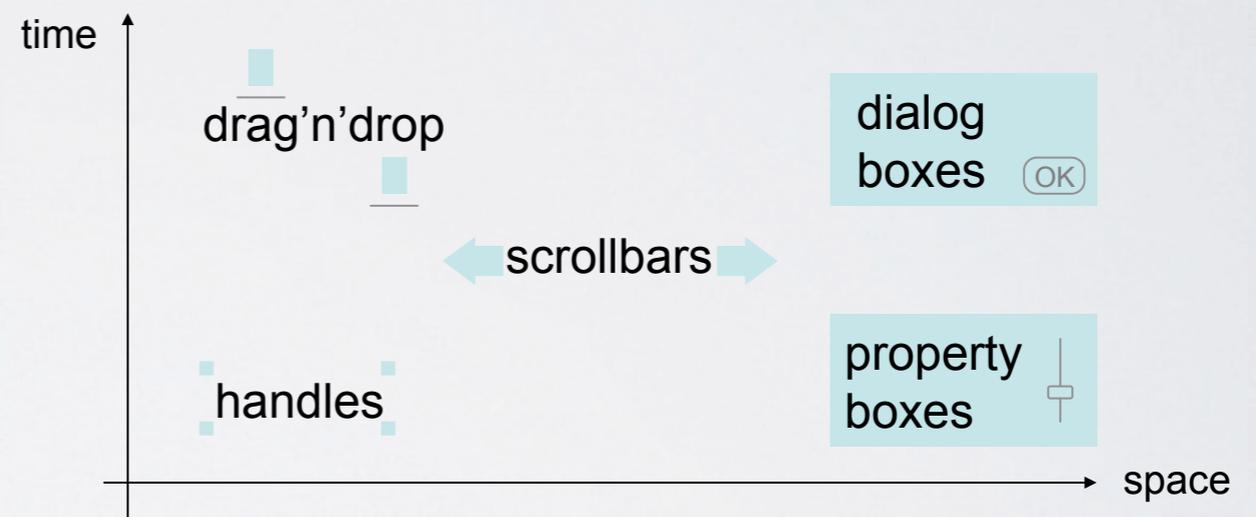


Instrumental interaction

- Provides metrics to compare instruments, for example:

- Degree of indirection

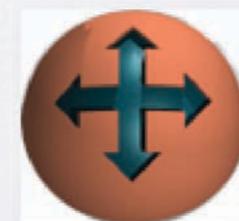
- Degree of integration



2=>1



2=>3

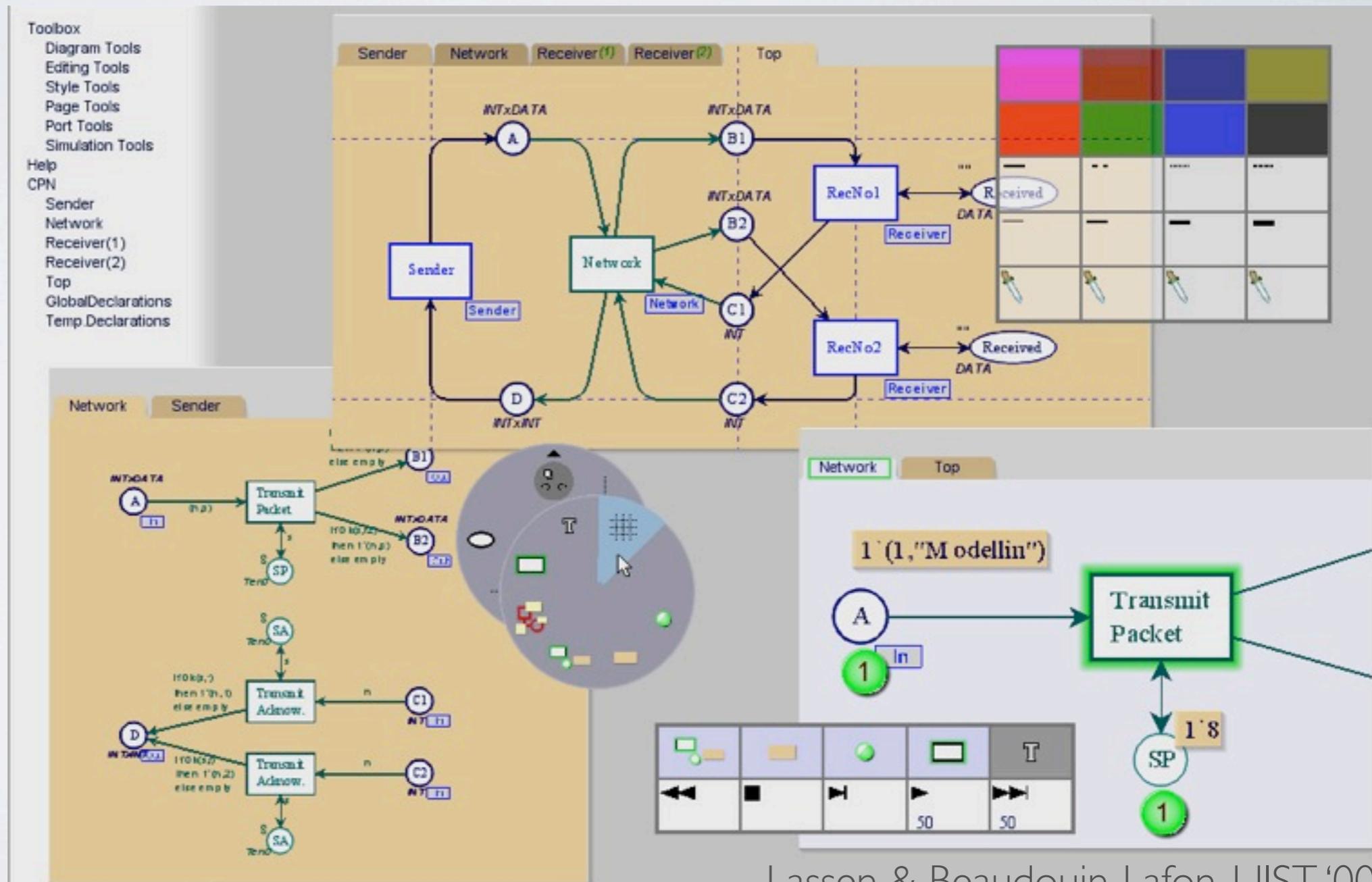


Proof-of-concept: CPN2000

- Bi-manual interaction, Marking menus, Toolglasses

- Combine power and simplicity

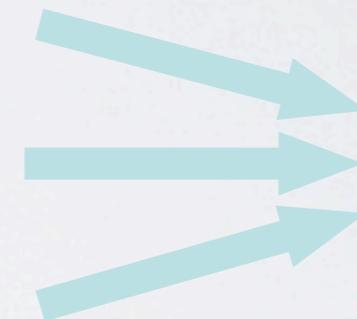
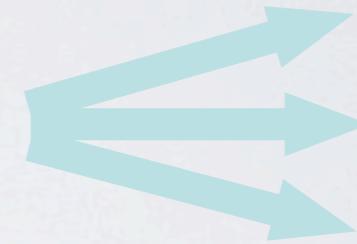
- 40 000+ downloads



Lassen & Beaudouin-Lafon, UIST '00

Design principles

- **Reification:** extends the notion of what constitutes an object
- **Polymorphism:** extends the power of instruments with respect to objects
- **Reuse:** provides a way of capturing and reusing interaction patterns

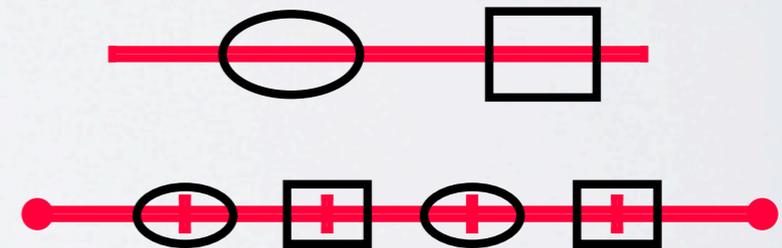
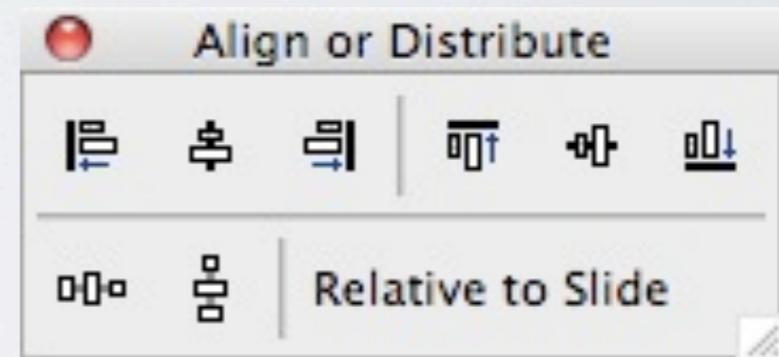


Example: aligning objects

- Align command:
align now and forget it

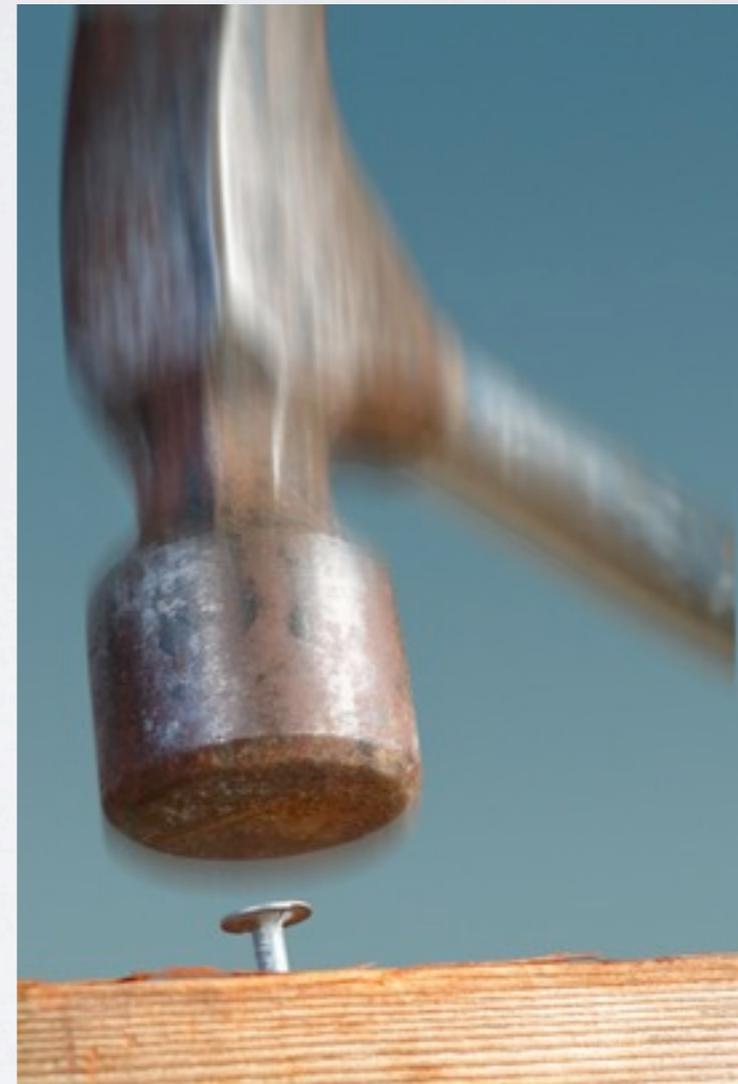
vs.

- Align instrument:
align and keep aligned

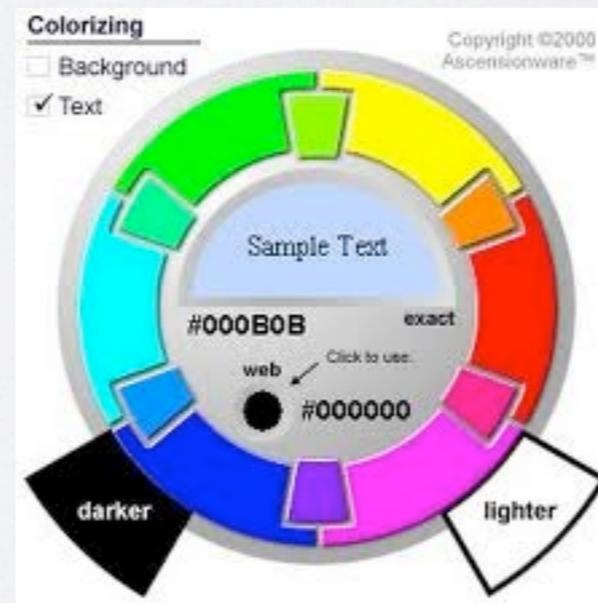
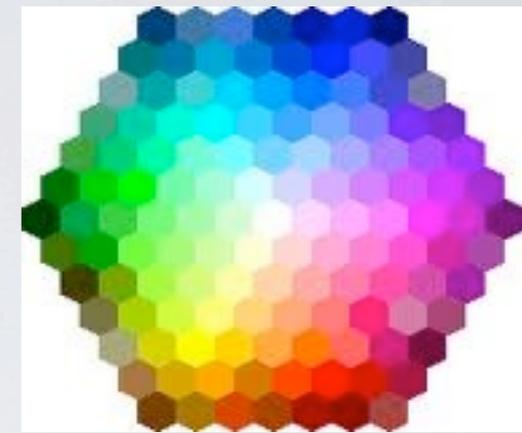
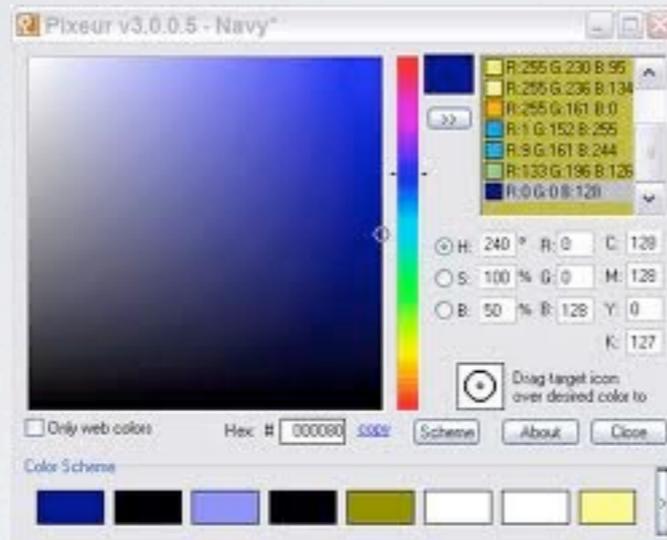


Benefits of instruments

- Decouple data/information from the tools used to view/edit it
- Provide a natural way to support user customization
- Foster a different business model for software, based on components and interoperability

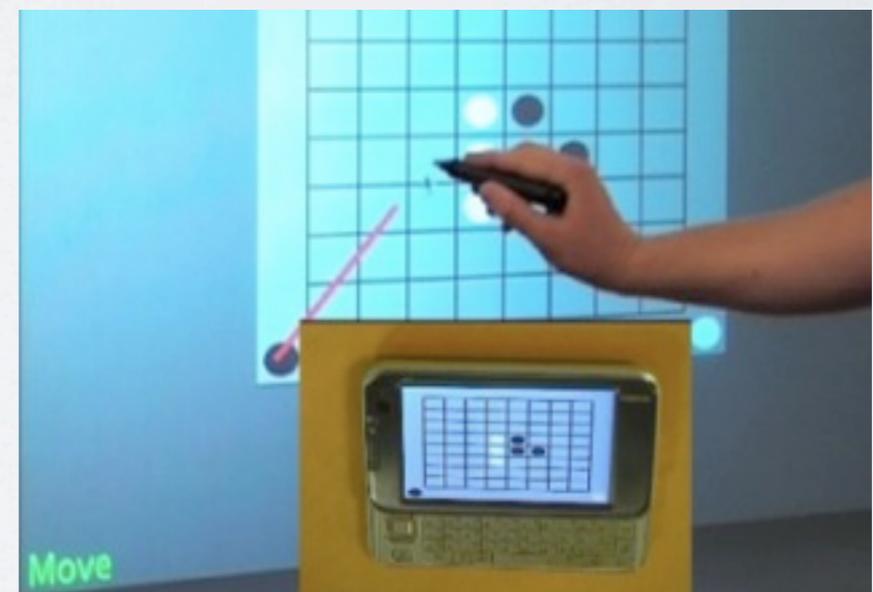
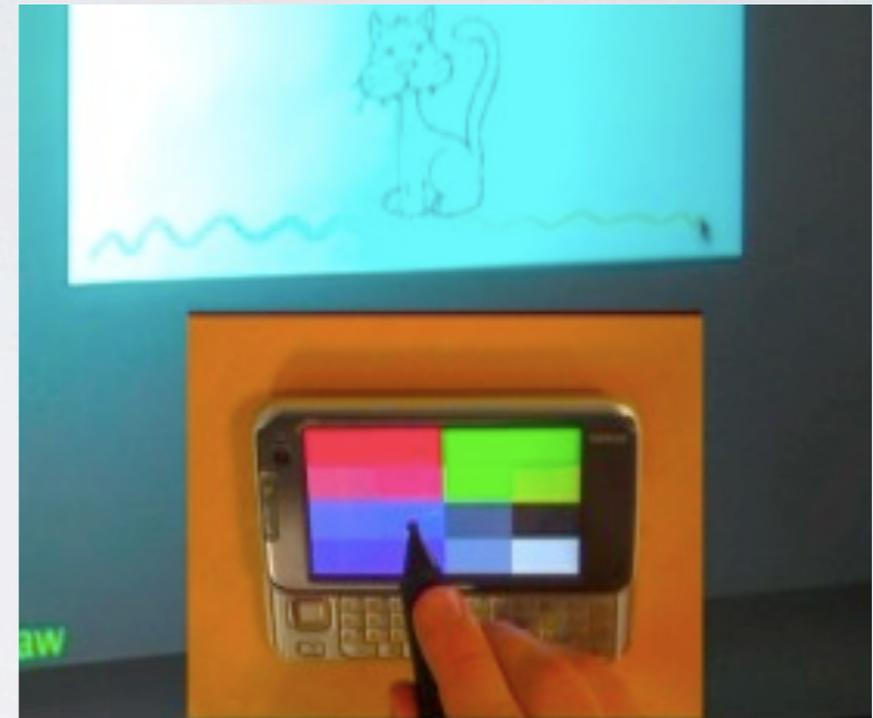


Example: color pickers

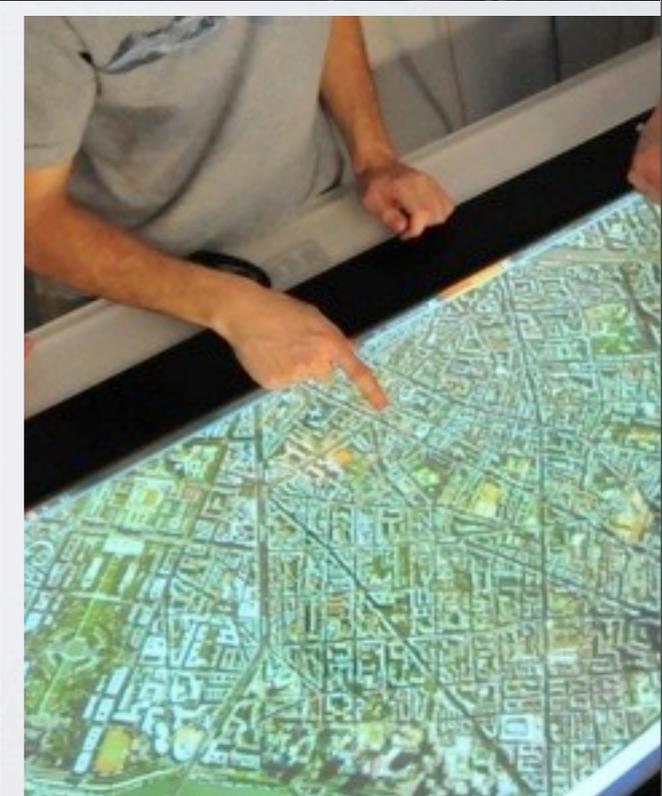


Ubiquitous Instrumental Interaction

- Detaching instruments from the objects of interest ... and from applications
- Instruments spanning multiple interaction surfaces
- **Multisurface interaction**

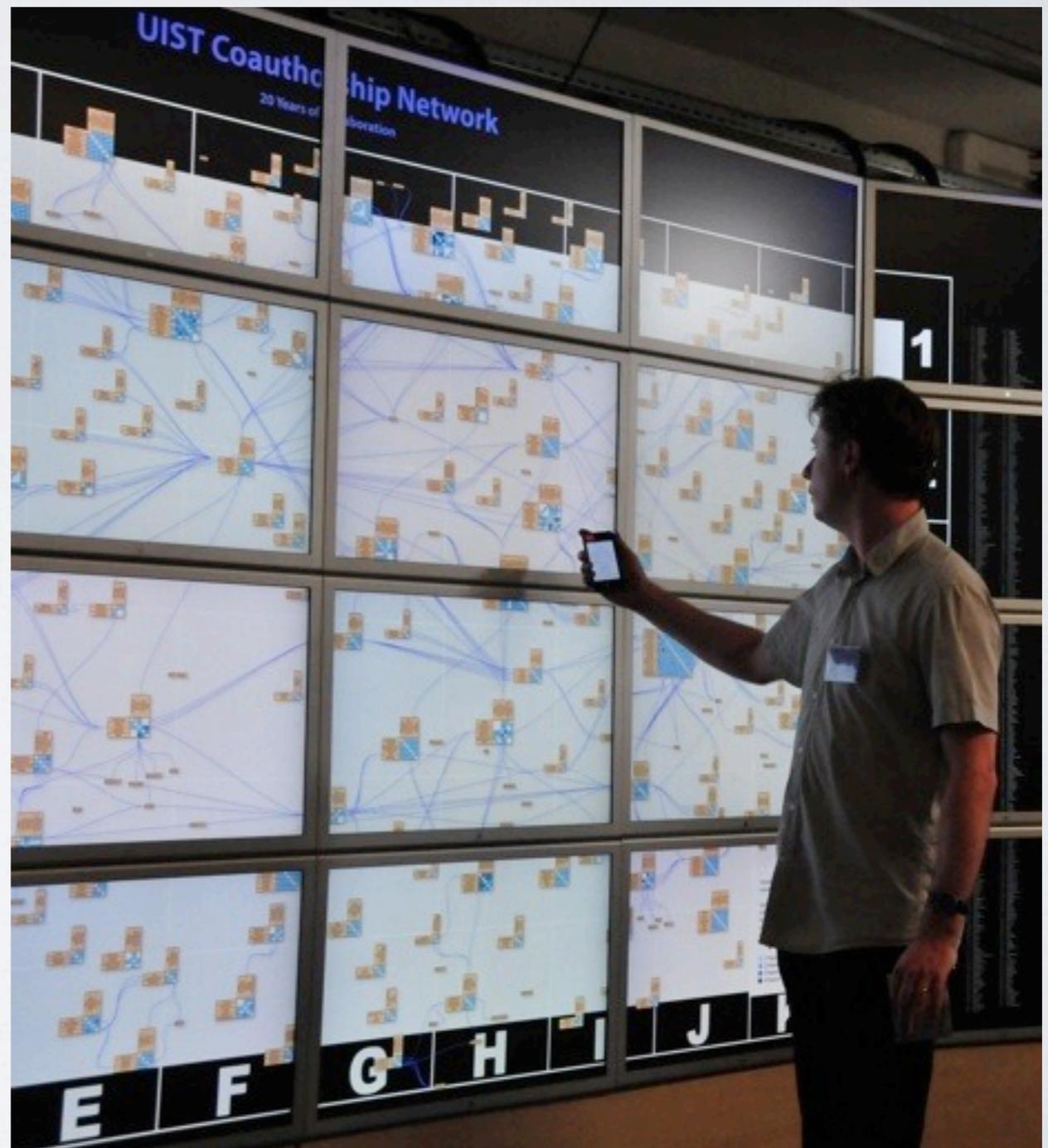


Klokrose & Beaudouin-Lafon, CHI '09



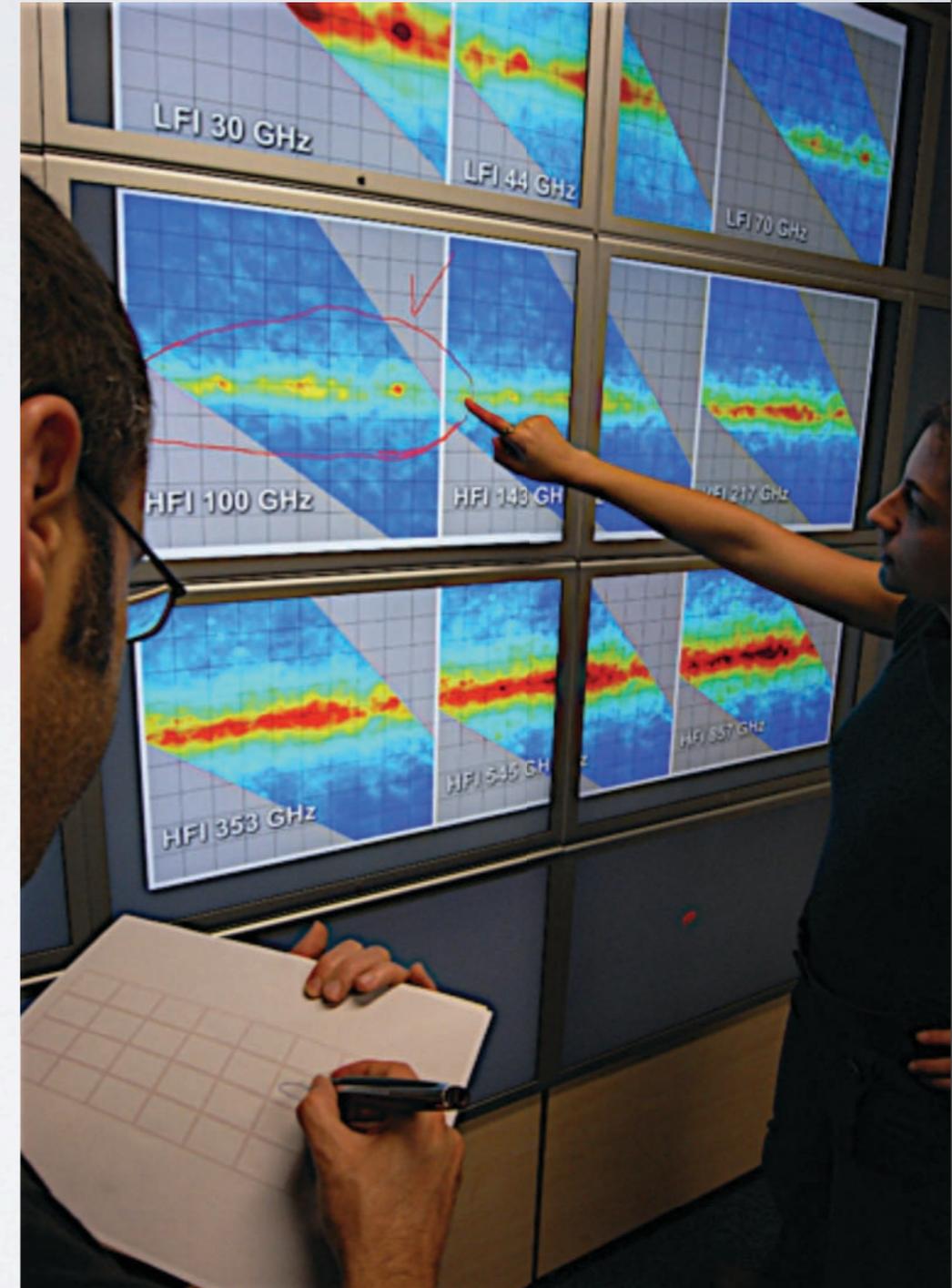
Key points of the WILD platform

- Focus on Interaction & Collaboration (rather than rendering)
- Very large size + Ultra-high resolution + Multiple surfaces = Unique affordances
- Off-the-shelf components



Participatory design

- Lead users: scientists who analyze big data



Participatory Design

- Create new ways to interact in a multisurface environment

Participatory Design

- Create new ways to interact in a multisurface environment



Prototype

Prototype



Software

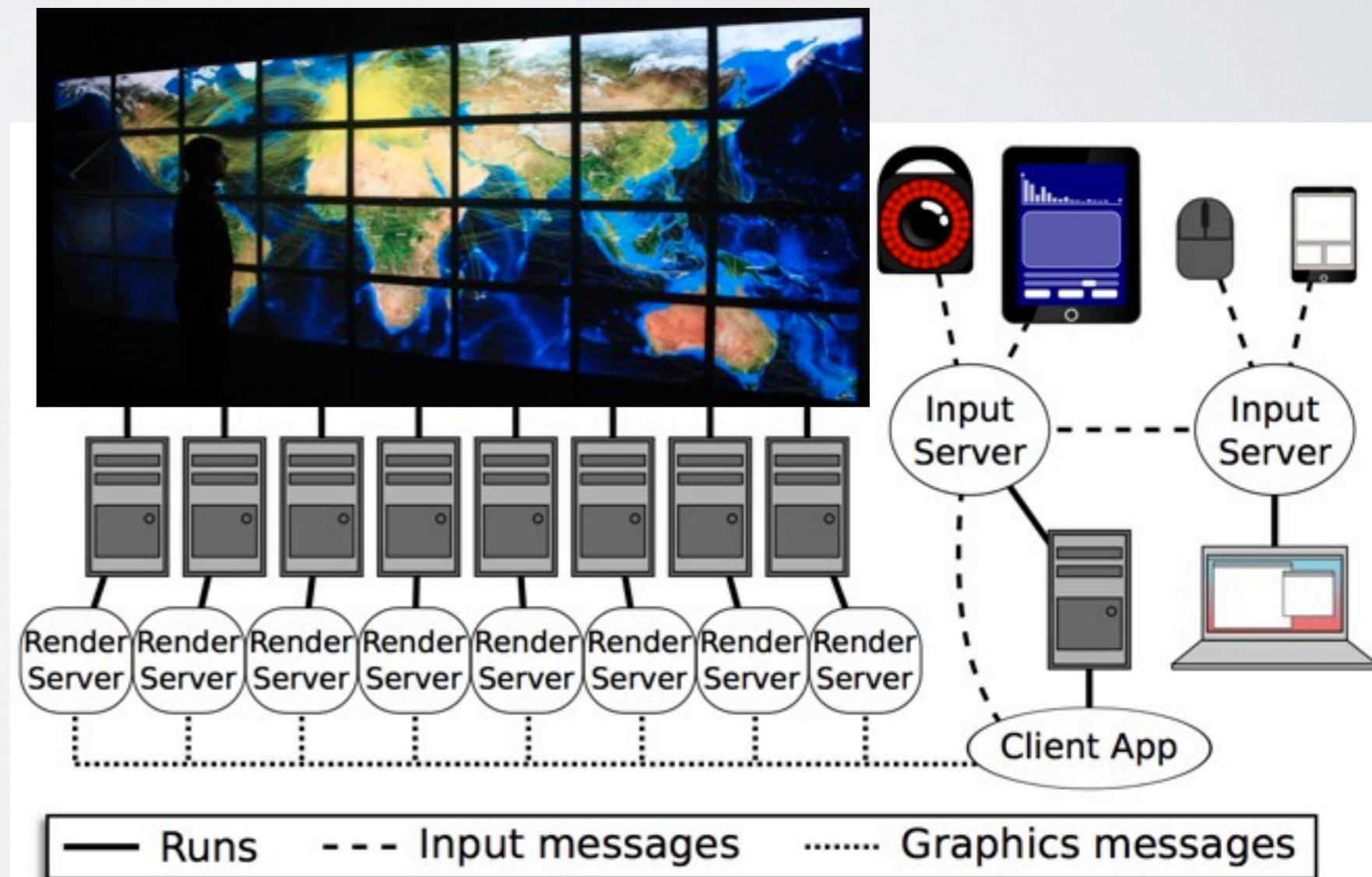
- Implemented from scratch, incorporates legacy applications

- **Rendering:**

replicate the full application at each node

- **Interaction:**

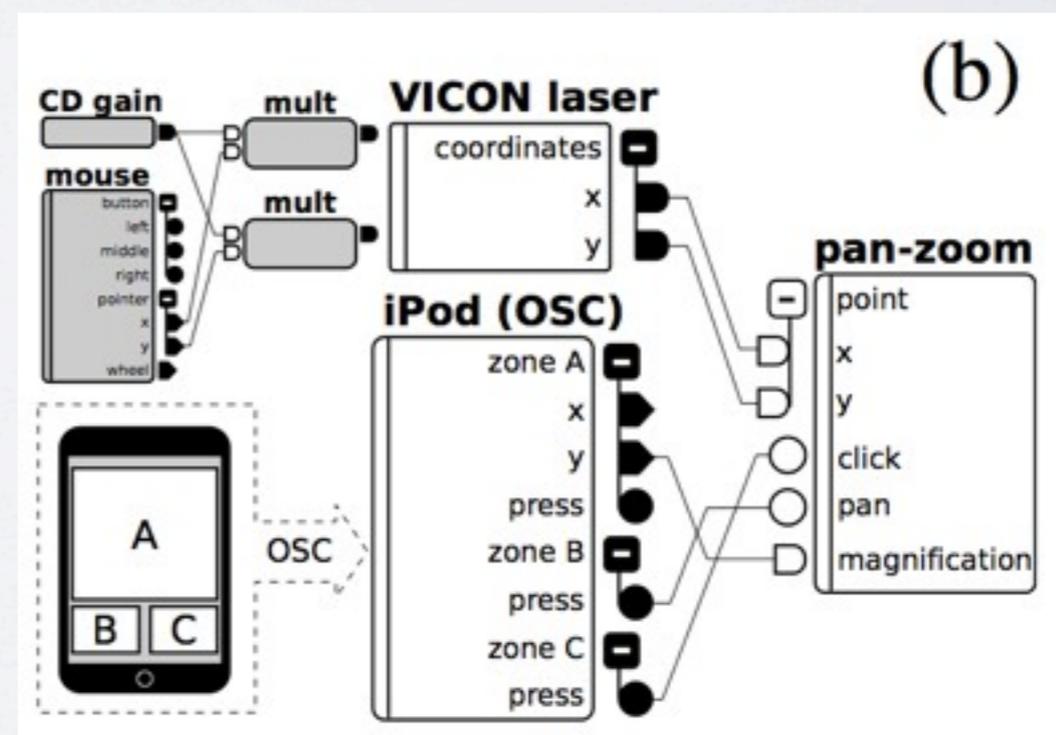
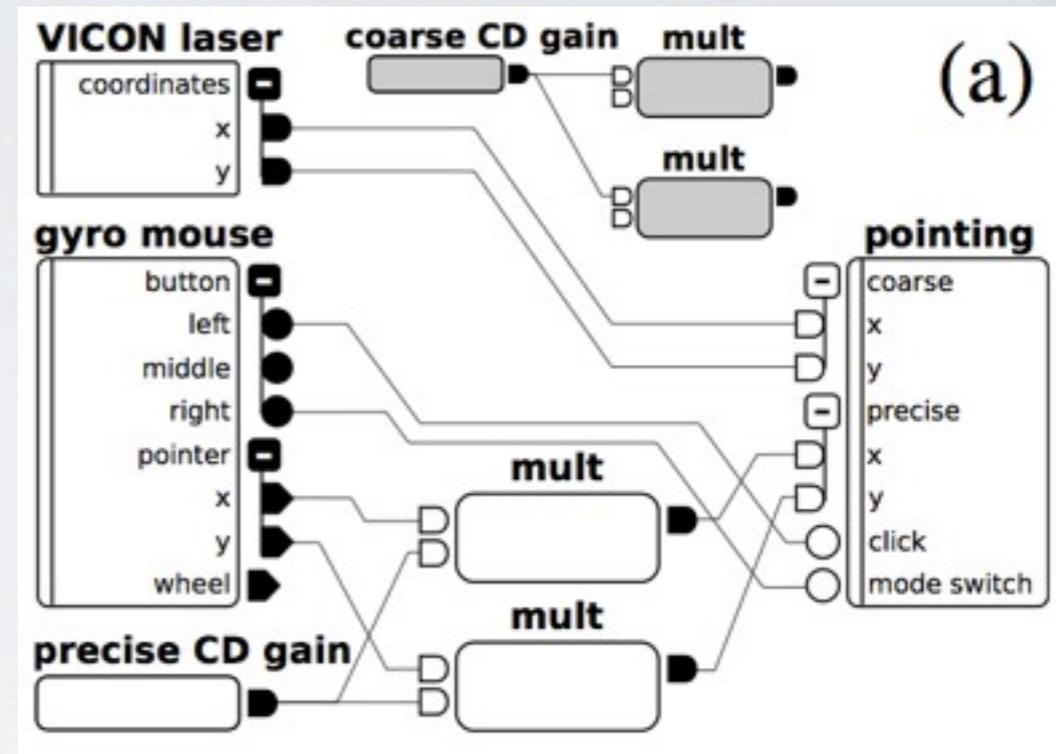
aggregate and distribute input



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Software: Wild Input Server

- Aggregate input from multiple devices, e.g. touch input on iPhone + 6D position of iPhone
- Easily reconfigure input
- Ability to prototype in desktop environment
- Uses the OSC protocol and the Input Configurator



Software: ZVTM

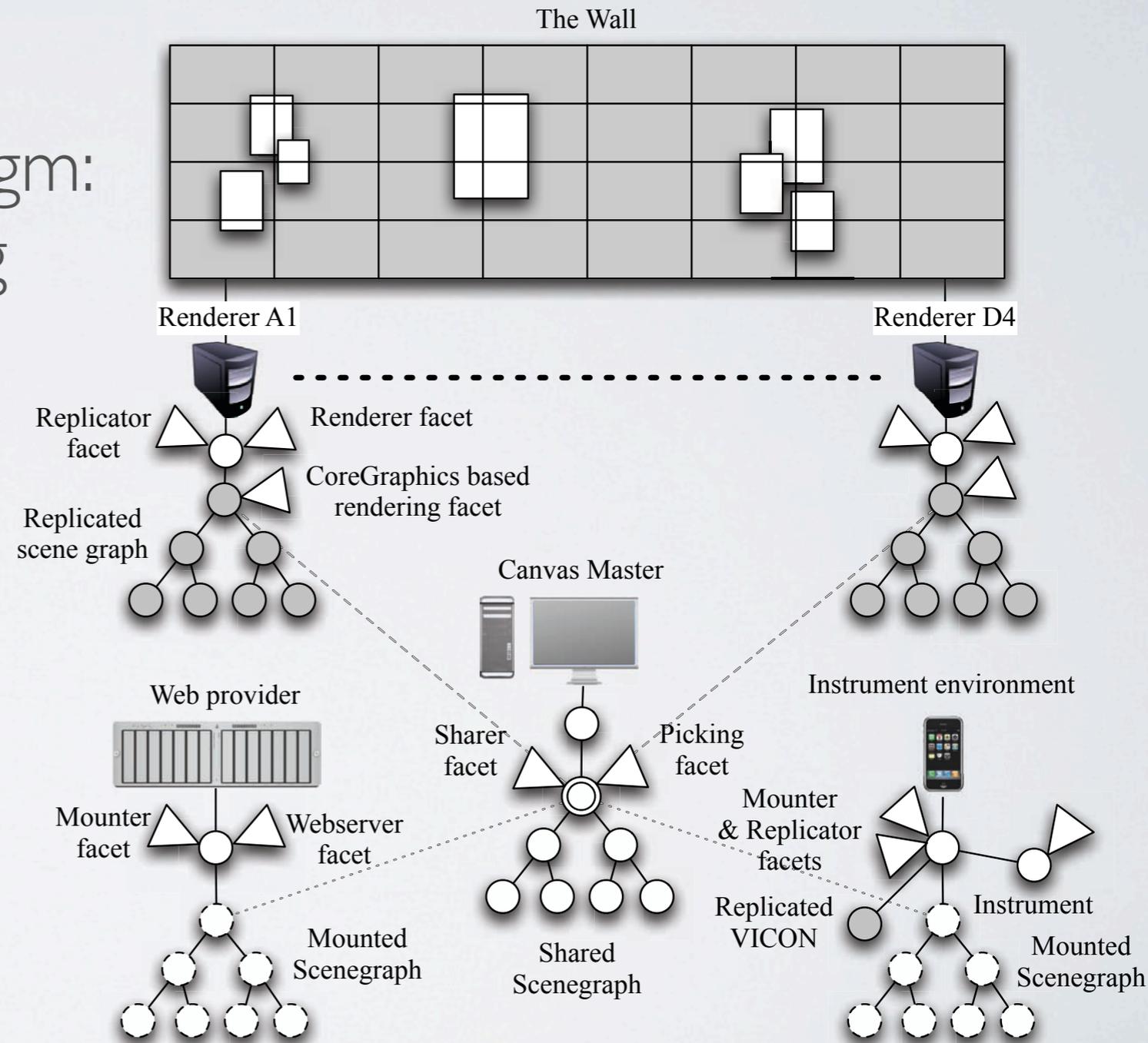
- Zoomable User Interface toolkit
- Distributed over the cluster
- Manage gigapixel images and complex multiscale scenes in real time



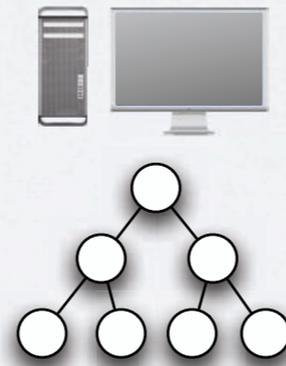
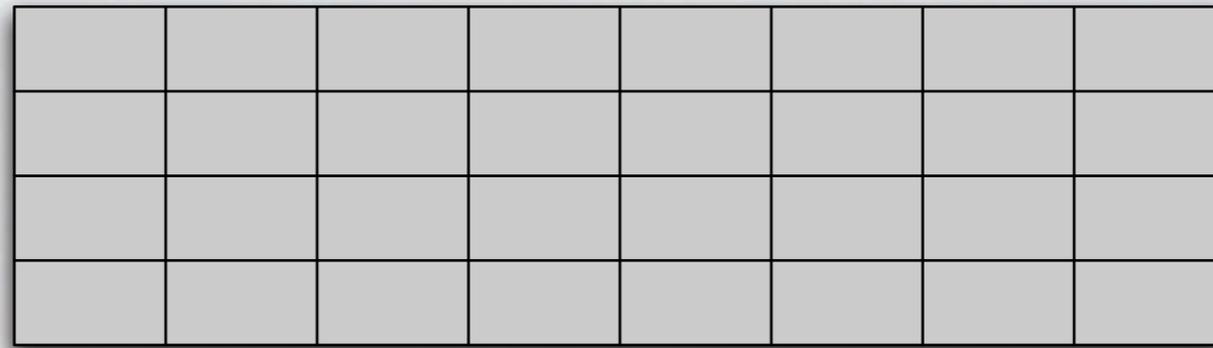
Pietriga et al., EHCI '11

Software: Substance

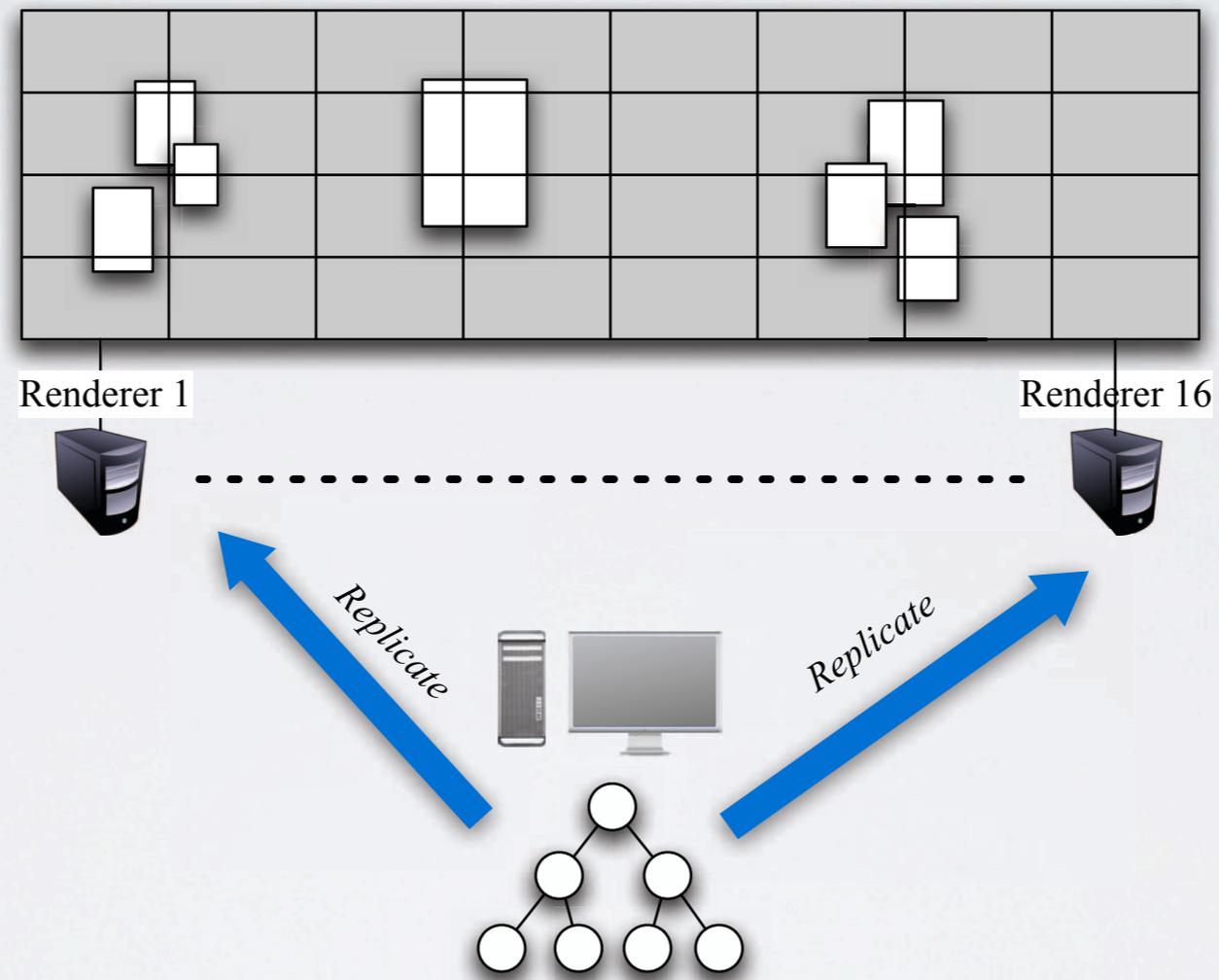
- Novel programming paradigm: data-oriented programming
- Separate data (nodes) from behavior (facets)
- Sharing nodes and facets: replication or mounting
- Multisurface instrumental interaction



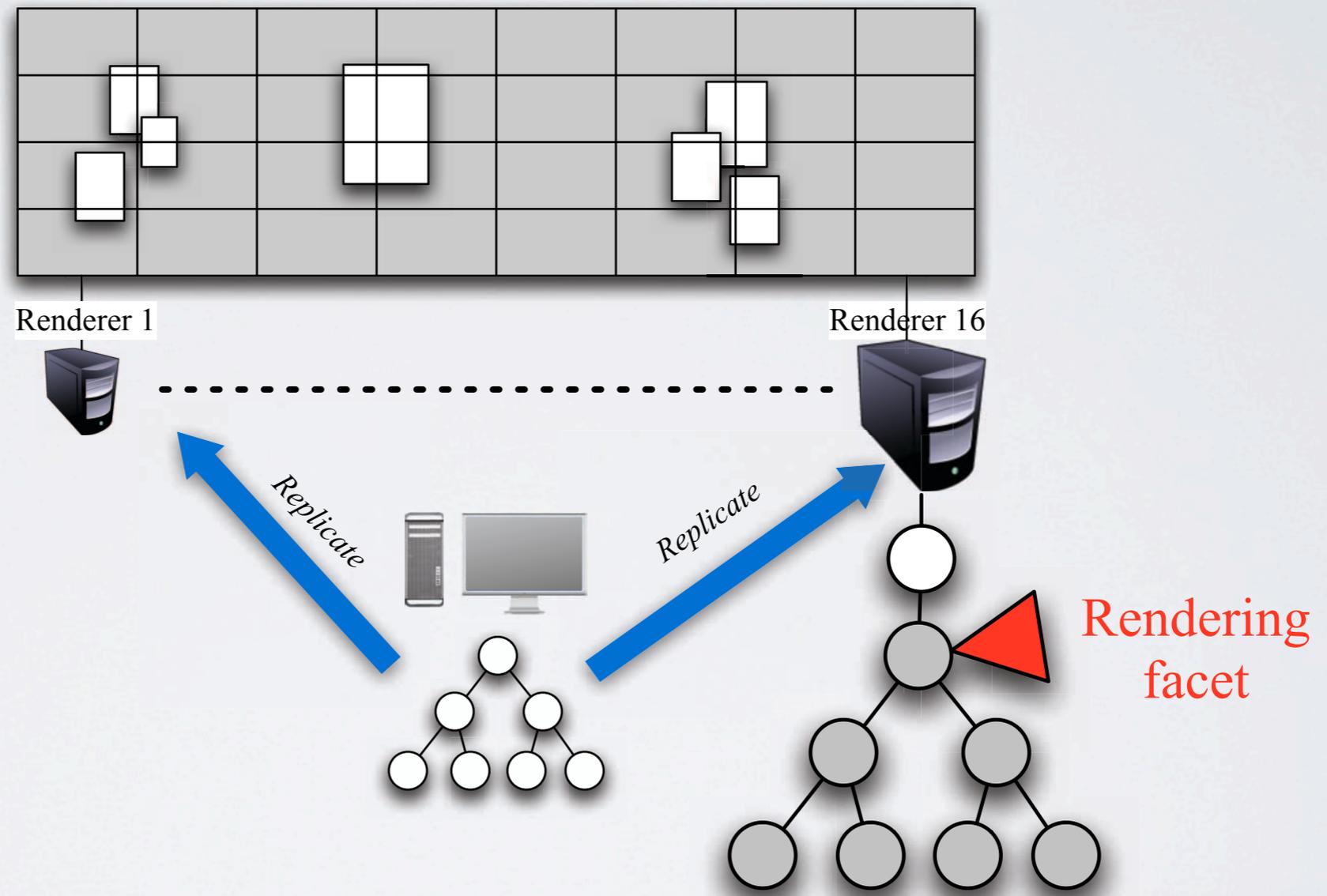
Shared scene graph



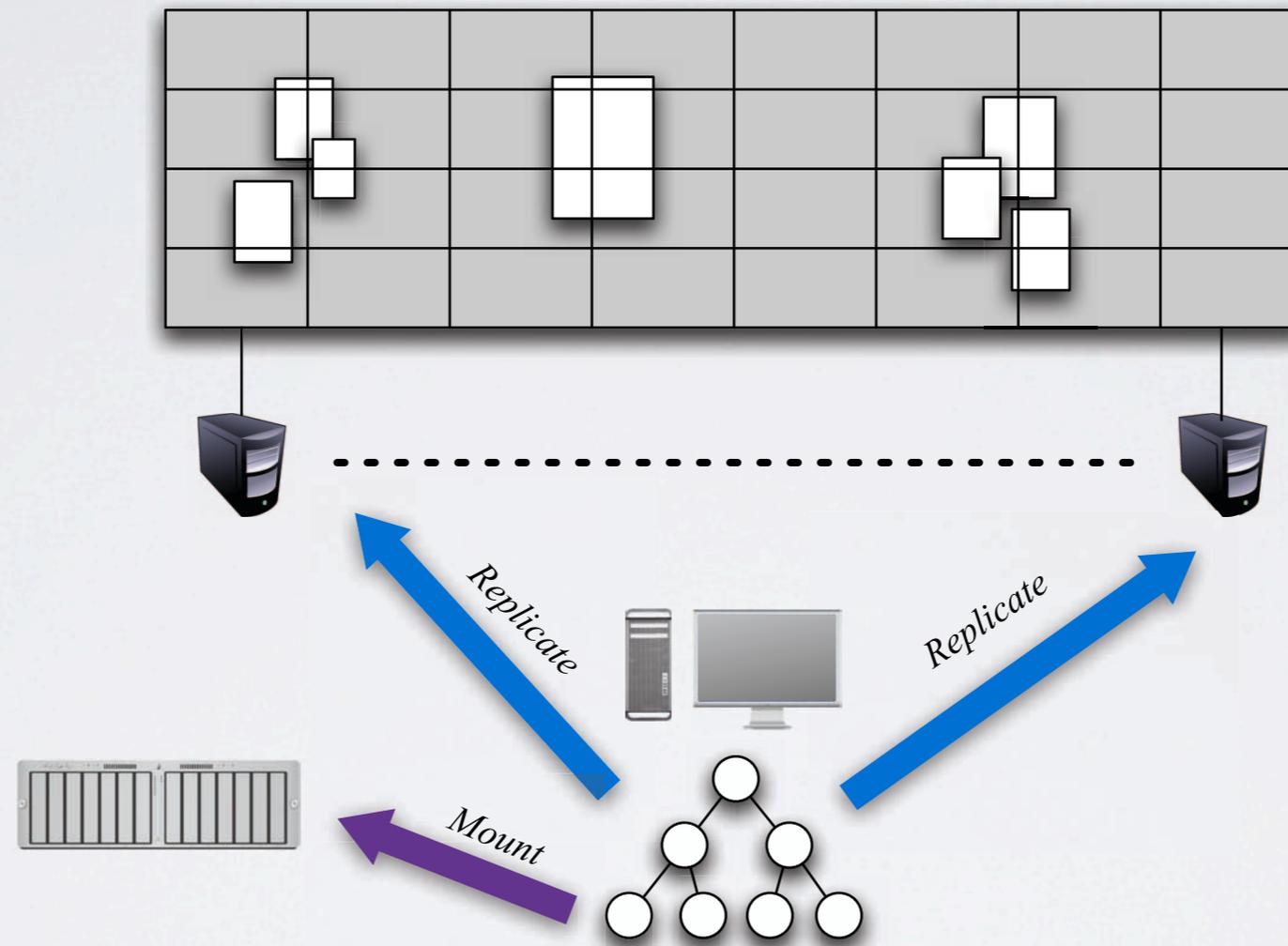
Rendering on the wall



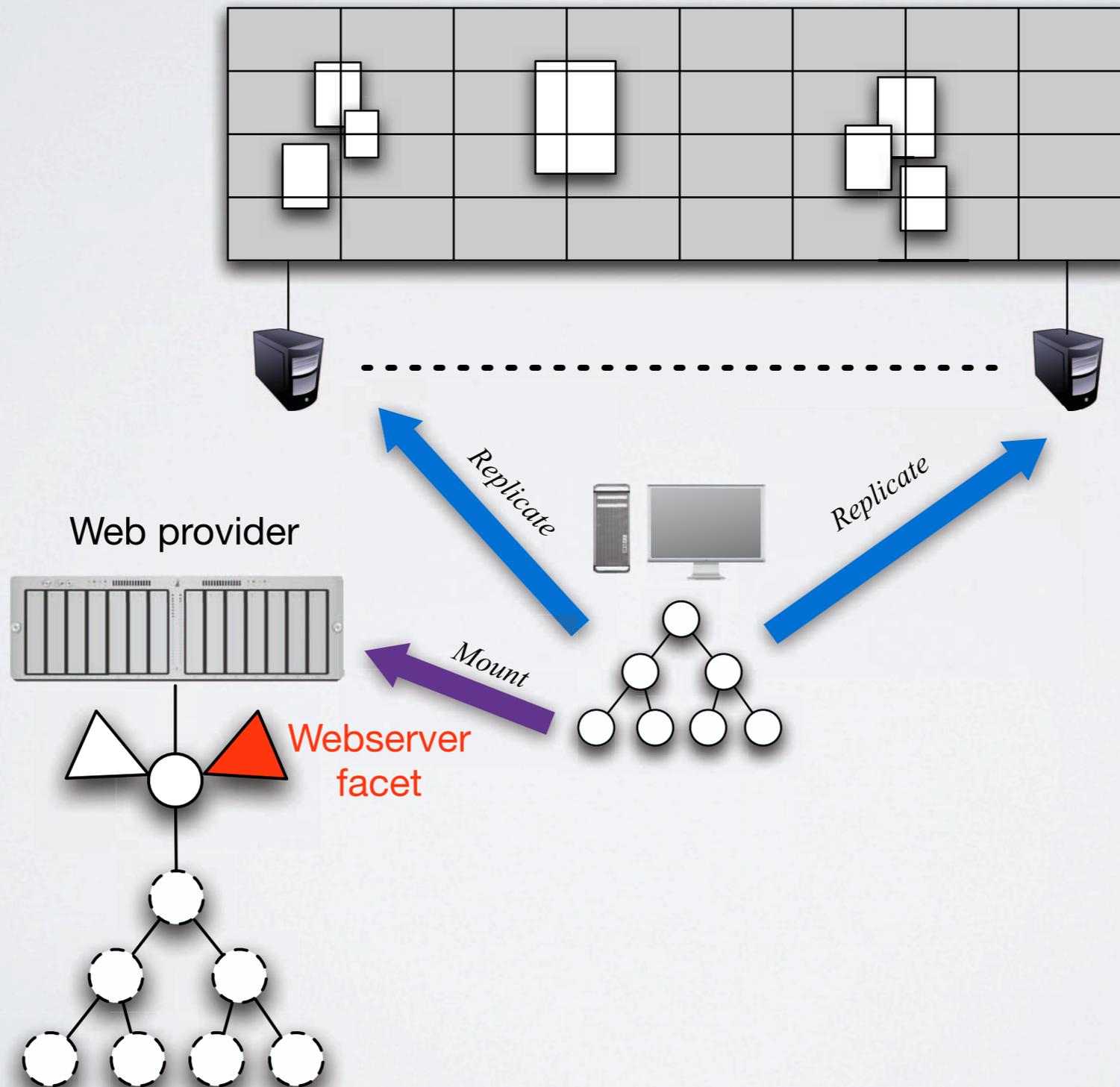
Rendering on the wall



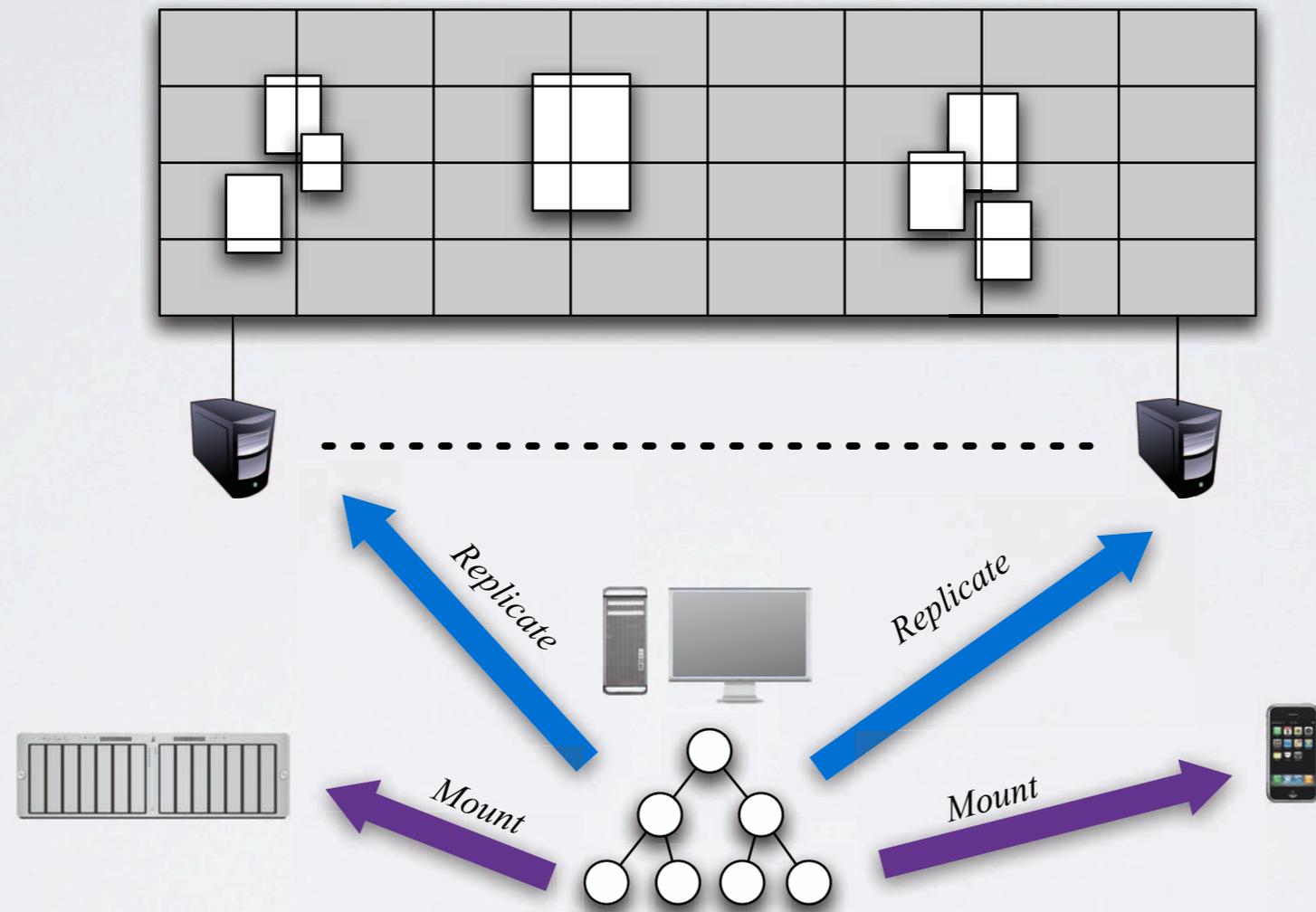
Content providers



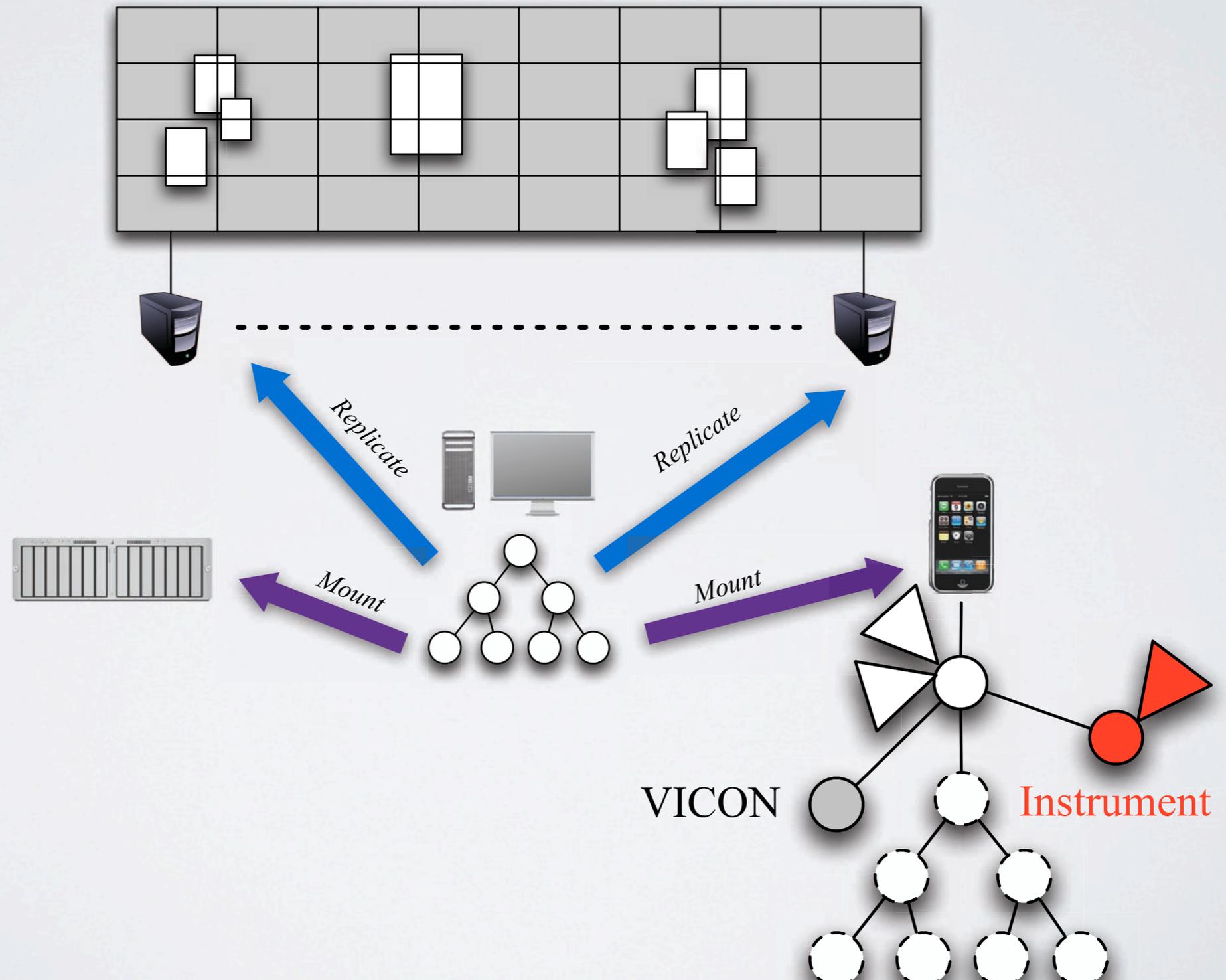
Content providers



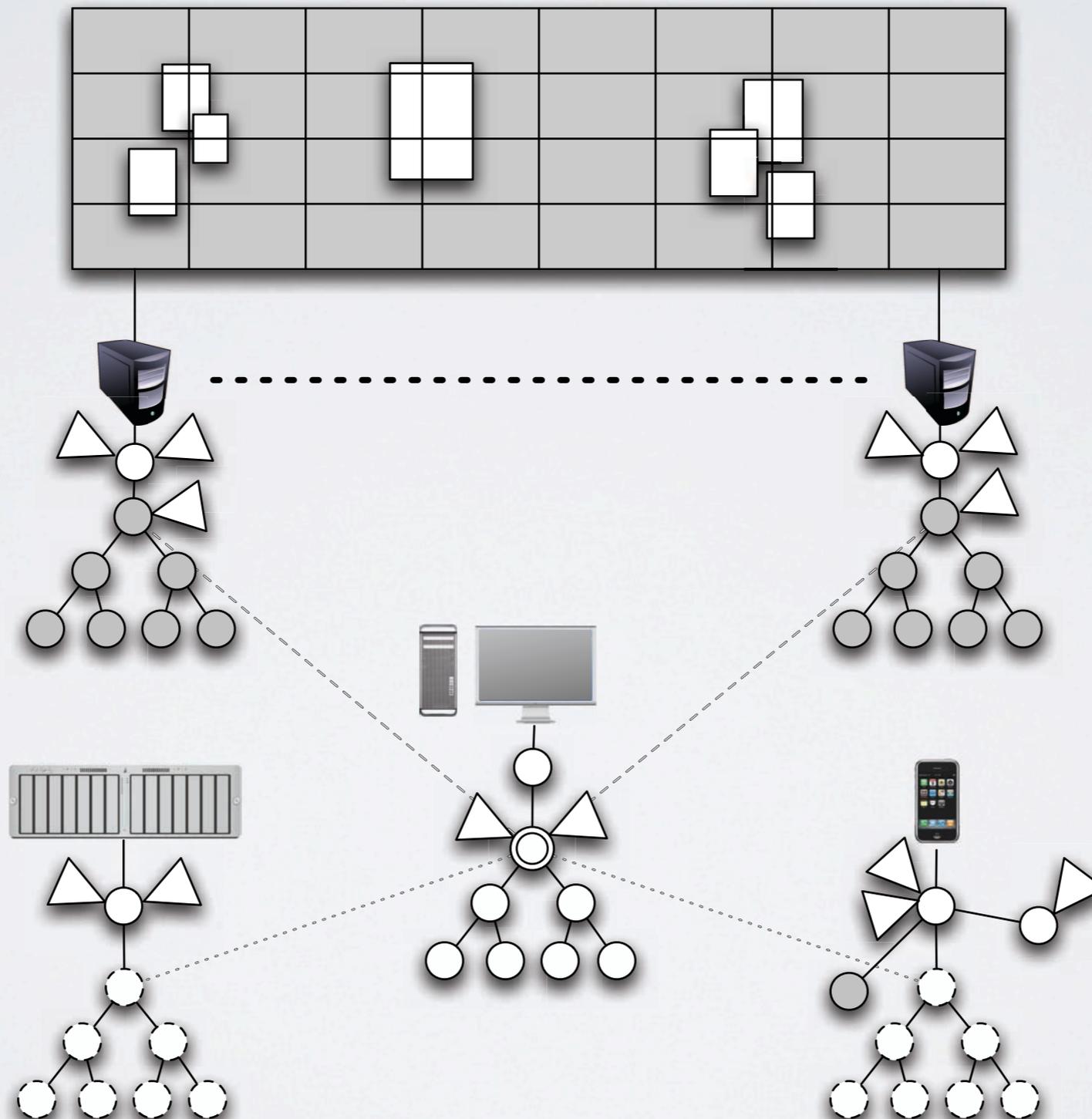
Instruments



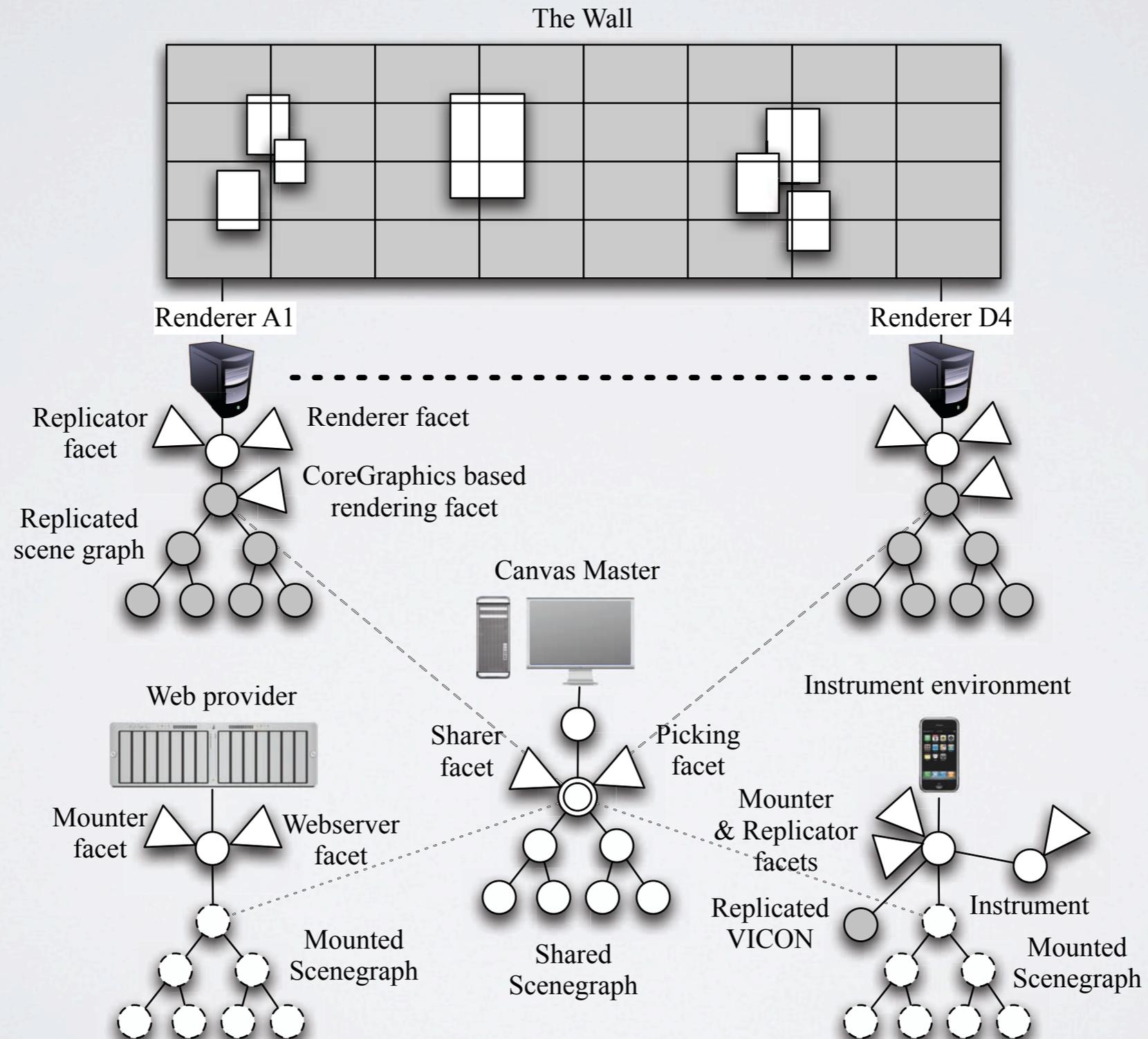
Instruments



Substance Canvas

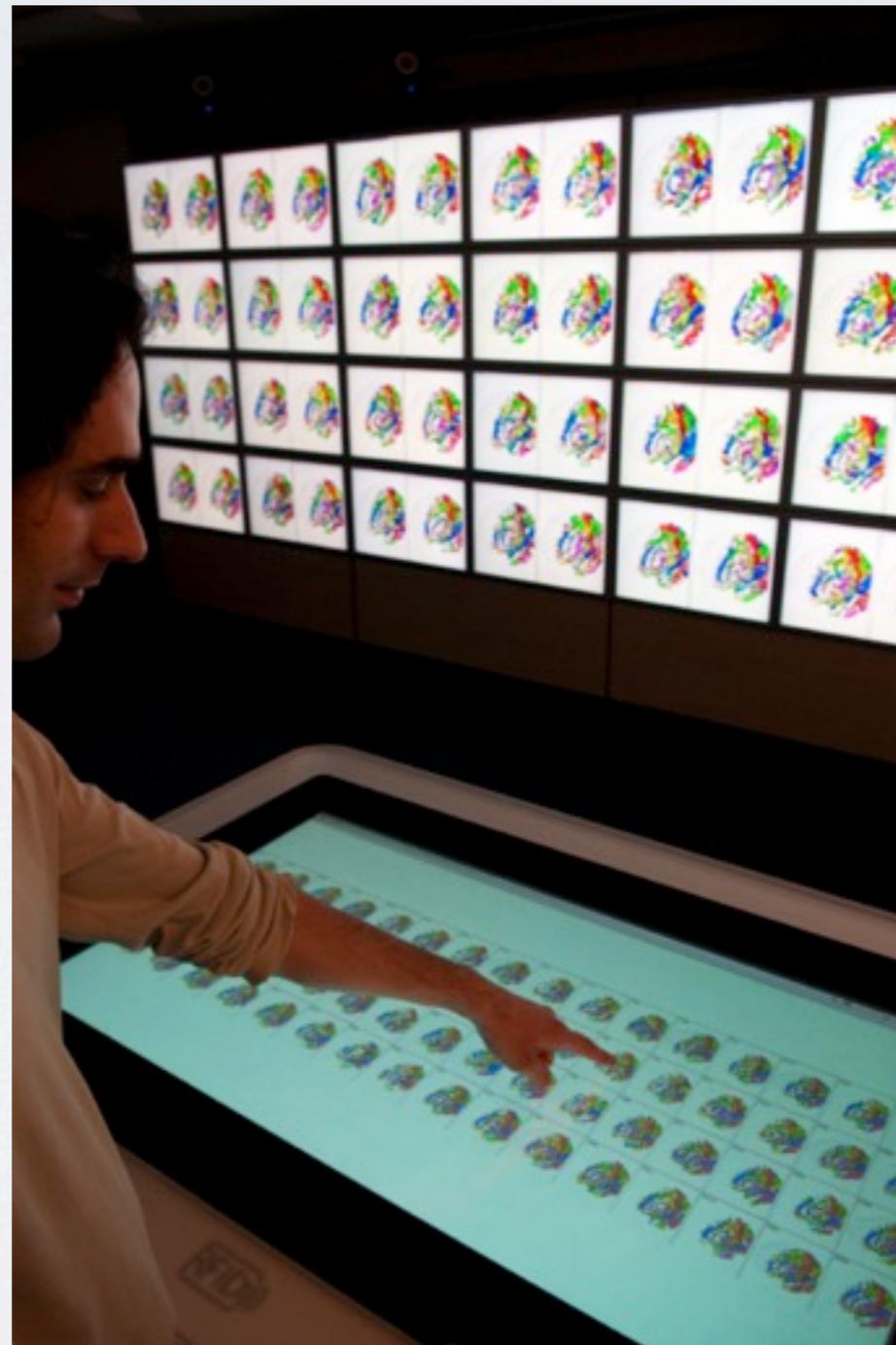


Substance Canvas

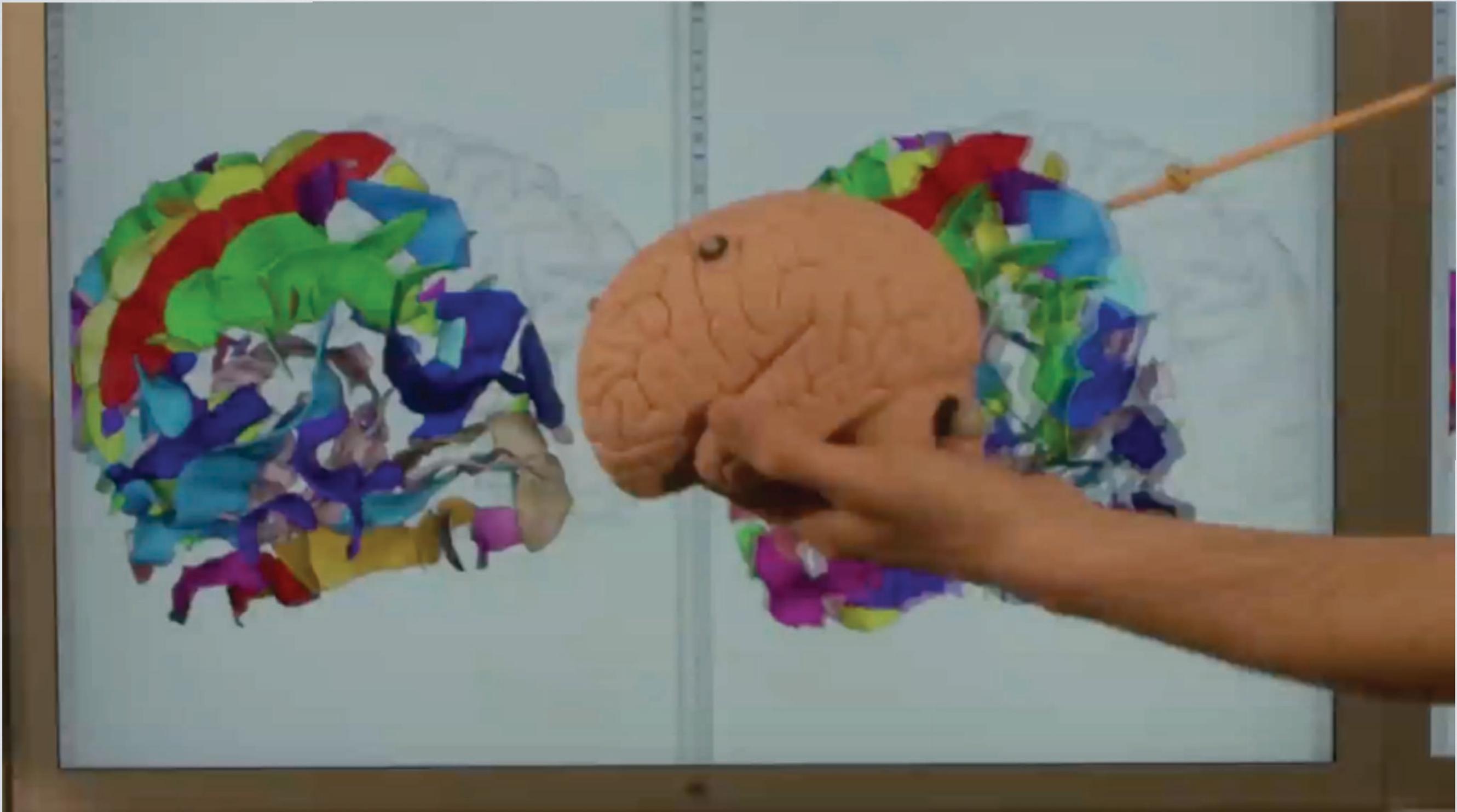


Software: Substance Grise

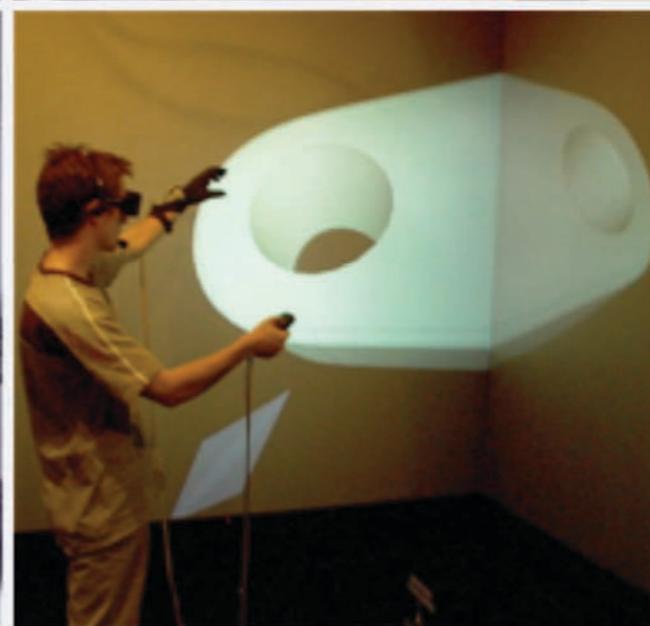
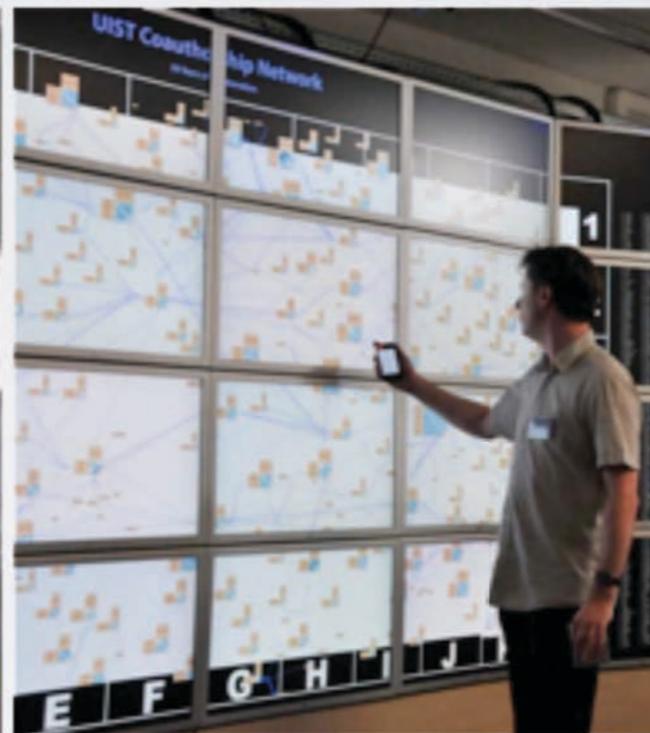
- Display 64 3D brain scans with BrainVISA / Anatomist
- Organize them on the table
- Control their orientation in real time through a prop



Substance Grise



Next Step: Digiscope



- 9 rooms interconnected by telepresence in the Paris area
- Remote collaboration
- Open to external partners

Summary

- **Instrumental Interaction**
can get us out of the tarpit of applications
- **Multisurface Interaction**
can help realize the vision of Ubicomp
- Both have sound conceptual models
and can serve as bases for software frameworks

Next steps

- Refine the conceptual model
 - Information substrates
 - + interaction protocols
 - + instruments
 - Explore the use of instruments with objects they were not designed for
- Build a robust and scalable software infrastructure
- Test in various settings – especially remote collaboration



Thank you!

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